

# THE PHEASANTS OF THE WORLD



PAUL A. JOHNSGARD



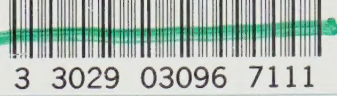
The pheasants are one of the most important groups of birds for man. They include the most abundant domesticated species (the domestic fowl), the most extensively hunted upland game bird (the common pheasant), and some of the most spectacularly beautiful of all large birds, such as the giant argus.

This book gives up-to-date information on the distribution, status, and biology of all the 49 extant species of pheasants. Special attention is paid to the status of vulnerable, rare, and threatened species.

The 53 colour plates in the book show adults of all the pheasant species. They are reproduced from early twentieth-century watercolours by Henry Jones in the possession of the Zoological Society of London, augmented by new watercolours specially painted by Timothy Greenwood for the book. The Jones watercolours, which are of exceptional quality, have not before been reproduced as a set. There are also many line drawings and maps showing the distribution of the various species.


Paul Johnsgard is Foundation Professor of Life Sciences at the University of Nebraska—Lincoln. He is the author of many books about birds, one of which earned him the Wildlife Society's annual award for the outstanding book in the field of terrestrial wildlife biology.





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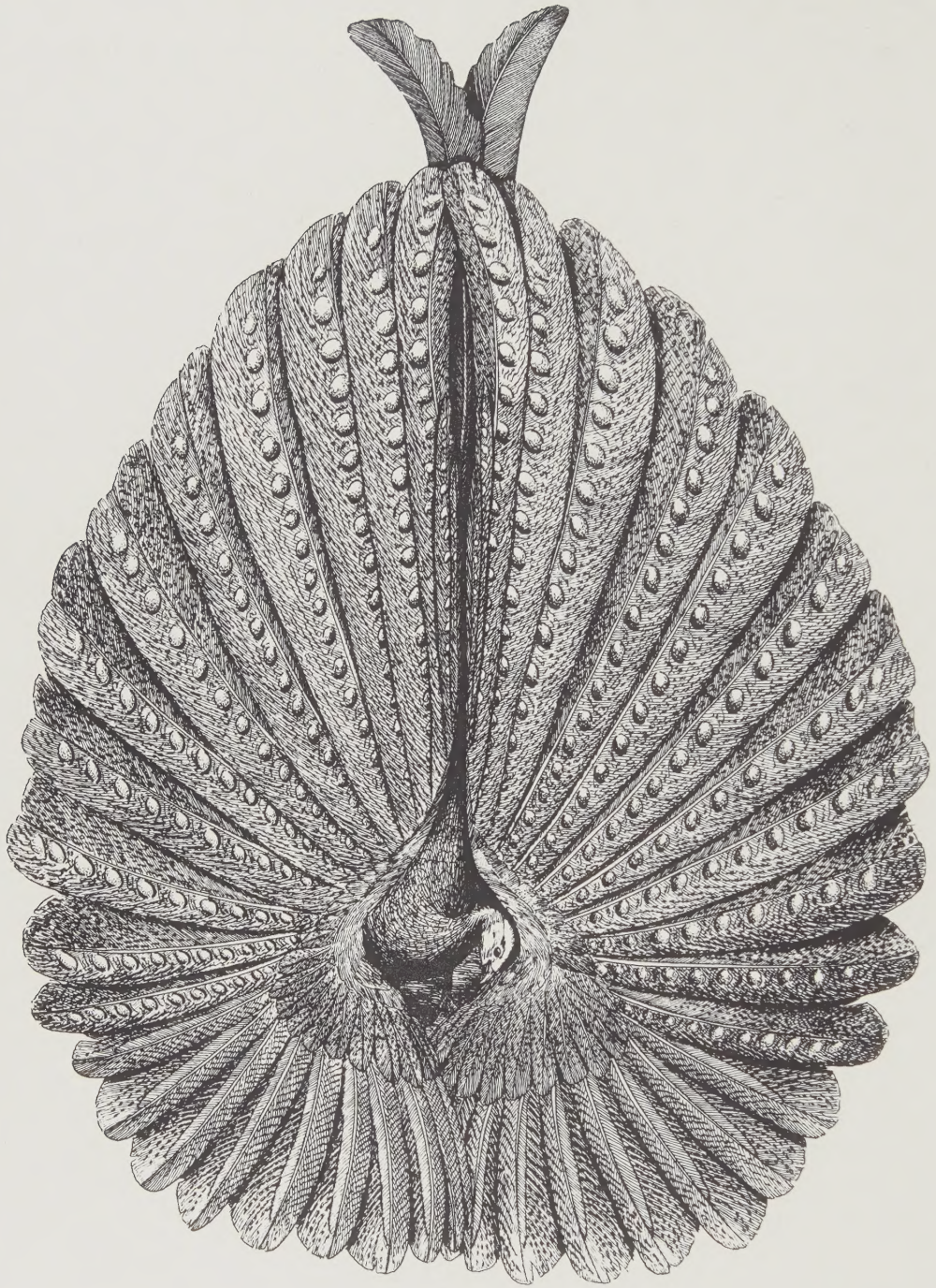
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THE PHEASANTS OF THE WORLD







# *The Pheasants of the World*

PAUL A. JOHNSGARD

*University of Nebraska—Lincoln*

*Colour plates of paintings by*

MAJOR HENRY JONES

*from the collection owned by*

THE ZOOLOGICAL SOCIETY OF LONDON

Oxford New York Tokyo  
OXFORD UNIVERSITY PRESS

1986



Oxford University Press, Walton Street, Oxford OX2 6DP

Oxford New York Toronto  
Delhi Bombay Calcutta Madras Karachi  
Kuala Lumpur Singapore Hong Kong Tokyo  
Nairobi Dar es Salaam Cape Town  
Melbourne Auckland

and associated companies in  
Beirut Berlin Ibadan Nicosia

OXFORD is a trade mark of Oxford University Press

Published in the United States  
by Oxford University Press, New York

© (text) Paul A. Johnsgard, 1986  
© (Plates 1–28, 30–52) Zoological Society of London, 1986  
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British Library Cataloguing in Publication Data

Johnsgard, Paul A.  
The pheasants of the World  
1. Pheasants  
I. Title  
598'.617 QL696.G27  
ISBN 0-19-857185-2

Library of Congress Cataloging in Publication Data

Johnsgard, Paul A.  
Pheasants of the World.  
Bibliography: p.  
Includes index.  
1. Pheasants. I. Title.  
QL696.G27J64 1986 598'.617 85-7218  
ISBN 0-19-857185-2

Set by Promenade Graphics  
Printed in Great Britain by  
R. J. Acford, Chichester, Sussex

*In memory of  
Jean Delacour  
(1890-1985)*



## Publisher's note

The idea for this book was originally suggested by the Zoological Society of London, which put forward the name of Professor Johnsgard as the author and made available for reproduction the Henry Jones watercolours in the Society's collection. The help and cooperation of the Society are gratefully

acknowledged. Especial thanks are due to Dr Marcia A. Edwards, Assistant Director of Science, Mr R. Fish, the Society's Librarian, and Mr. T. J. Dennett, who undertook the photography of the paintings.

It is hoped that further volumes of similar type may be published in conjunction with the Society.

# Foreword

*by Lord Zuckerman*

In the distant days of Empire there were many British officers and officials—sometimes even school-masters—who had the vision to take advantage of their postings in distant parts of the world to develop an interest in the natural history of the new environments in which they found themselves. Sometimes what started as amateur curiosity developed into a professional concern with the study of anthropology, or of zoology or botany, or even of geology and palaeontology. Several who began as amateurs left a permanent mark on their fields of interest. They sent specimens back to scholars and museums in the United Kingdom. They contributed to learned journals, and a few even launched scientific societies—such, for example, as the Bombay Natural History Society, still a thriving institution. There were also some who laboured alone year after year, compiling with brush and pen voluminous records of what they were observing, with ever-increasing professionalism. Several of these compilations have survived, and a few still wait to be properly studied and described: for example the fifteen, fat, folio volumes of notes left by Alfred Brown, a schoolteacher and postmaster who for some fifty years, in the latter half of the nineteenth century and well into the 1900s, laboured in what was then the Cape Colony, now a part of the Repub-

lic of South Africa, excavating fossils, many of them of mammal-like reptiles, of which a small collection was sent to the British Museum, and for which he justifiably felt he had never received sufficient credit.

One of the compilations that is already known consists of some twelve hundred exquisite paintings of birds which were made by a Major Henry Jones. Little is known of his career, and when he died in 1921 the Zoological Society of London was very fortunate to have bequeathed to it the whole collection. Had the resources then been available, there is little doubt that the Society would have seen to their publication. But it was not until 1976 that a small selection was published in a magnificent volume, jointly by the Society and the Folio Fine Editions, to mark the 150th Anniversary of the Society's foundation. The Jones archives have now been mined again, and Professor Johnsgard has used 51 of Major Jones's paintings to illustrate his book on the pheasants of the world. This book will be read and consulted by ornithologists world-wide, and it is our hope that the value of these paintings will be appreciated by other distinguished scholars who may also wish to illustrate authoritative works with selections from this unique collection.





# Preface and acknowledgements

Because of their beauty, economic importance, and value as sporting birds, the pheasants have received more than their share of attention from writers. Their first major monographer, D. G. Elliot, authored what has often been described as the most beautiful monograph on birds ever produced when he published his *Monograph of the Phasianidae, or family of the pheasants*, between 1870 and 1872, with its 82 superb hand-colored lithographic plates by Joseph Wolf. Only four decades later (1918–1922) C. W. Beebe similarly produced a four-volume work titled *A Monograph of the pheasants*, which was among the last of the great bird monographs of that era, and which employed the artistic talents of six of the finest bird artists of the period. Both of these monographs were produced in highly limited numbers, and are essentially unobtainable today.

However, Jean Delacour remedied this situation with a modern treatment of the pheasants in his book *The pheasants of the world*, which was published initially in 1951, and republished in a slightly revised version in 1977. This volume had the stamp of Delacour's taxonomic authority as well as reflecting his vast background in both avicultural techniques and field experience with pheasants in southeast Asia. Delacour's book is especially heavily oriented toward avicultural information rather than data on naturalistic ecology and breeding biology, although the limited amounts of information available even today in these areas makes such an orientation understandable. Nonetheless, it has appeared to me for some years that an alternative treatment, which emphasizes these aspects of pheasant biology, and devotes the least possible attention to descriptions of subspecies and avicultural histories, might be warranted. This idea was reinforced when I chanced on a very large series of unpublished pheasant watercolours made by Major Henry Jones at the beginning of the 20th century, while doing research in the library of the Zoological Society of London. My immediate hope was that a book might be built around these paintings, which are certainly the equal of many of the most famous earlier pheasant plates, such as those done by Joseph Wolf for Elliot's famous monograph. After extended discussions with the Zoological Society of London and Oxford University Press this hope finally materialized, and I was able to make a selection of more than 50 of the Jones plates for illustrating my book. These paint-

ings include 47 of the 49 forms of pheasants that I have regarded as full species. Two species that were not illustrated by Jones (because they remained undiscovered until a few decades later) have been commissioned by me, and I have been very fortunate in being able to obtain the help of a fine English artist, Timothy J. Greenwood, in achieving my goal of illustrating all the known species of pheasants with paintings. Not since Elliot's monograph have all the pheasant species been illustrated with individual colour plates that show both sexes in nearly all cases. Further, Delacour's (1977) monograph has only a few literature citations more recent than 1950, and none more recent than 1976. I have thus concentrated on summarizing the most recent available literature, especially of citations not to be found in Delacour, and on trying to summarize the current conservation and distributional situation as well as available information allows for each species.

One cannot produce a book unaided, and in addition to the artistic help of Timothy J. Greenwood I was particularly aided by various members of the World Pheasant Association. Dr Timothy Lovel and Mr and Mrs Keith Howman were particularly influential in many ways, and the Howmans were unflinchingly helpful in providing advice and allowing me to photograph their marvellous pheasant collection. Similarly, Mr John Bayliss loaned me a number of very useful photographs, Major Iain and Didy Grahame provided me with useful advice, Raymond Sawyer and Charles Sivelles provided me with access to their collections, and other WPA members helped in other ways. Additionally, Mr Vern Denton let me observe his collection of extremely rare pheasants, and David Rimlinger of the San Diego Zoo helped me in innumerable ways, by loaning photographs, providing otherwise unavailable data on pheasants, and reading an early draft of the manuscript. Mr Kenneth Fink was always most generous in loaning photos, providing advice, and in hosting me during a stay in San Diego. Mr George Allen Jr. and Lincoln Allen also provided me with several useful photos.

The use of several excellent libraries was invaluable to me during the preparation of this book, and I must in particular mention the assistance I received from the Edward Grey Institute of Oxford University, and the libraries of the Peabody Museum of Natural History, Yale University, the Zoological



Society of London, the American Museum of Natural History, and the Van Tyne Memorial Library of the University of Michigan. I also acknowledge with gratitude the use of specimens in the collections of the British Museum (Natural History), the American Museum of Natural History, and the Peabody Museum of Natural History.

Work on this book was done between 1982 and 1984 at the University of Nebraska–Lincoln, and was greatly facilitated by a Faculty Development Leave provided me during the spring semester of 1983. I also appreciate the typing assistance given me by the secretaries of the School of Life Sciences, and by Janet Kumke.

Several persons at the Zoological Society of London were important in my work, particularly Mr Reginald Fish, Librarian, who cheerfully complied with my every request for help or information. Dr Marcia Edwards assisted me in the earlier stage of finding a publisher acceptable to all parties, and Dr Peter Olney also provided me with various sorts of assistance. Finally, the foreword was very kindly written by Lord Zuckerman.

*Lincoln, Nebraska*  
1985

P.A.J

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# Introduction

The pheasants (tribe Phasianini as used here) comprise a group of 49 species of generally non-migratory and terrestrially adapted birds of moderately large size. A hind toe is always present, and all the toes have short, fairly blunt claws, suitable for scratching. The wings are relatively short and rounded, and in general extended flight is unusual or impossible. Thus, most species are relatively sedentary, although limited migrations do occur. The birds are primarily vegetarians, and all species have well developed crops for temporary storage of food, as well as muscular gizzards associated with grinding of hard food materials with the aid of grit. The feathers usually have well-developed aftershafts, but down is scanty or lacking. Their nests are typically unlined shallow scrapes on the ground, and the eggs are usually fairly numerous and either unspotted or only slightly spotted. The young are precocial, and often are able to fly short distances within a week or so after hatching. The species are variably monogamous or non-monogamous, with the former condition much rarer and seemingly the more generalized form, from which polygyny (harem-formation) and promiscuity have evolved under appropriate ecological conditions.

Pheasants differ from other major subfamilial subgroups of the Phasianidae (the grouse and New World quails) in having tarsi and nostrils that are unfeathered, toes that are neither feathered nor have lateral pectinations, a lower mandible that is always smooth and unserrated, and in lacking the inflatable oesophageal 'air sacs' typical of male grouse. Complete distinction from the very closely related Old World partridges (tribe Perdicini) is difficult, but in general pheasants tend to be larger birds, and exhibit greater sexual dimorphism in both size and plumage. Highly iridescent plumage colouration and sharply spurred tarsi are common in male pheasants, and they also often have tails that are either highly graduated or variably vaulted, or both.

All pheasant species are native to the Old World, and the majority are found between the equator and the tropic of Cancer, in tropical to temperate climatic regions and in variably forested habitats between sea level and 9000 ft elevation.

Although the pheasants thus occur in what are still some of the least-studied terrestrial environments in the world, they have by no means escaped the effects of man, and indeed pheasants are among the most seriously impacted of all major bird groups as a result of human exploitation and habitat destruction. A total of 18 species, or nearly 40 per cent of the entire group, were listed as rare, endangered or vulnerable in the most recent *Red data book* (King 1981). Yet the pheasants have been of enormous benefit to man, providing the most numerous and widely domesticated species of bird, the domestic fowl. Similarly, the common pheasant is the single most widely distributed and abundant species of upland gamebird; estimated annual harvests in North America alone have at times approached 20 million birds. Several other species have been introduced in North America and elsewhere in the world for similar sporting purposes (Long 1981), and additionally pheasants are among the most popular of all bird groups for aviculturists and exhibition in zoos. As of 1979, no less than 46 of the 49 species of pheasants recognized here were known to be represented in captivity, and the total population was probably then in excess of 25 000 individuals (*World Pheasant Association Journal* 4, 72–75). However, this figure is small by comparison with the number of domestic fowl present in the world today, which certainly number several billion. Even the ring-necked pheasant has a captive population numbering the tens of millions; in the United Kingdom alone it is estimated that about seven million of these birds are released every year (Savage 1981, p. 79).

P.A.J.





# I · COMPARATIVE BIOLOGY



# 1 · Relationships and classification

Most current taxonomic classifications of the pheasant-like birds are at least in some measure dependent upon early studies by Beebe (1914a) who, in preparation for the writing of his large monograph on the group, spent several months studying specimens in all the major museums of the world. After considering 'several scores' of anatomical characters of possible taxonomic significance, Beebe settled on using the sequence of moulting in the tail feathers (rectrices) as his primary criterion of generic groupings. He discovered that, at least in all the forms he studied, moult in the Old World partridge-like species invariably begins with the central rectrices and proceeds regularly outward. With the exception of the genera *Ithaginis* and *Tragopan*, none of the pheasants that he studied appeared to have such a moulting pattern. Thus, he distinguished the Old World subfamily *Perdicinae* (but also including the two pheasant-like genera just mentioned) on the basis of their centrifugal (from the middle) pattern of rectrix moulting. Furthermore, Beebe discovered that in most of the typical pheasants the moulting pattern of the rectrices was exactly the reverse, from the outermost rectrices inwardly (centripetally). Beebe considered all the genera of this group to comprise the *Phasianinae*. A major exception that he found involved the typical peafowl (*Afropavo* was still undiscovered at the time), which he observed to moult from a locus beginning with the second rectrices from the outermost, with the outermost pair moulting just prior to the inner ones. Beebe called this group the *Pavoninae*. Lastly, he observed that in the peacock pheasants and argus pheasants (*Polyplectron*, '*Chalcurus*', *Arguainua* and *Rheinartia*) the tail moult begins with the third from central pair, and proceeds both outwardly and inwardly simultaneously, with the central rectrices being replaced just prior to the outermost pair. This group of genera was called the *Argusianinae*. Stresemann (1965) later supported Beebe's observations, although studies of the Reeves' pheasant indicate that juveniles have a centrifugal tail moult while adults moult their tails in a centripetal pattern (Mueller and Seibert 1966).

Peters (1934) did not follow this taxonomic convention, but simply included all of the Old World partridges and their relatives as well as the typical pheasants in the subfamily *Phasianinae*, as indeed have several more recent classifications. Delacour

(1977) went even further in 'lumping' groups. He included the New World quails in the subfamily *Phasianinae* as well, and did not directly address the question of possible criteria for distinguishing pheasants from these other quail-like or partridge-like groups. He noted only that *Ithaginis* and *Tragopan* are 'slightly related' to the partridge-like forms. He nevertheless considered them sufficiently pheasant-like to be included in his monograph, while nonetheless excluding other similarly transitional forms such as *Galloperdix*.

The early observations of Beebe on pheasant moulting patterns have largely gone unchallenged, although Marien (1951) has made some comments about their taxonomic utility. He observed that in at least two genera of partridges (*Perdix perdix* and *Ammoperdix griseogularis*) the post-juvenal tail moult begins with the third or third and fourth pair of rectrices, and proceeds both laterally and medially, the pattern that Beebe described as typical of the subfamily *Argusianinae*. He also remarked that in one specimen of snow partridge (*Lerwa lerwa*) the moult pattern was imperfectly centripetal, casting further doubt of the universality of a centrifugal moulting pattern in the *Perdicinae*. Marien also noted that the wing moult might offer only limited value in separating *Phasianinae* groups. It has been suggested, for example, that the Old World partridges and quails and the New World quails agree in retaining the one or two (rarely three) outermost juvenal primaries during their post-juvenal moult, but that the true pheasants replace all of their juvenal primaries at this time. This situation does seem to apply to all of the New World quails so far studied (Johnsgard 1973), and also has been observed in several of the Old World partridge genera (*Perdix*, *Alectoris*, *Tetraogallus*, *Tetraophasis*, *Ammoperdix*). Yet it evidently is not invariable, for *Francolinus* is alleged to have a complete post-juvenal wing moult (Marien 1951). On the other hand, the *Phasianini* are supposed to have complete wing moults but Mueller and Seibert (1966) reported that the Reeves' pheasant retains its tenth juvenal primary through the first year, as do eared pheasants (Felix 1964).

Verheyen (1956) reviewed these and various structural traits that have been suggested as having taxonomic importance in the *Galliformes*, and proposed a new classification based largely on his proportional



measurements of the skeleton. Within his family Phasianidae, Verheyen recognized the following subdivisions:

1. Numidinae (5 genera)
2. Afropavoninae (monotypic, *Afropavo congensis*)
3. Meleagrinae (2 genera)
4. Tetraoninae
5. Perdicinae

Tribe Corturnicini (including *Coturnix*, *Synoicus*, *Excalfactoria*; probably also *Perdica*, *Cryptoplectron* and *Ophrysia*)

Tribe Perdicini (incompletely studied, but including the following species groups)

*Tetraogallus*—*Tetraophasis*—*Lerwa*

*Alectoris*

*Perdix*—*Arborophila*—*Tropicoperdix*—*Caloperdix*

*Ptilopachus*

*Acentrortyx*—*Margaroperdix*—*Ammoperdix*—*Melanoperdix*

*Rollulus*

*Francolinus*—*Pternistis*

*Bambusicola*

*Anurophasis*—*Rhizothera*

*Haematortyx*

6. Phasianinae (including the following species groups)

*Galloperdix*—*Ithaginis*

*Tragopan*

*Pucrasia*—*Houppifer* (= *Lophura erythrophthalma* and *L. inornatus*)

*Lophophorus*

*Lobiophasis* (= *Lophura bulweri*)—*Lophura*—*Hierophasis*

*Lophura* (including 'Lobiophasis', 'Hierophasis', 'Diardigallus', and 'Gennaesus')—*Syrnaticus*—*Phasianus*—*Chrysolophus*

*Gallus*

*Crossoptilon*—*Catreus*—*Polyplectron* (including 'Chalcurus')

*Rheinartia*—*Argusianus*

7. Pavoninae (including *Pavo* only)

Verheyen's strong separation of *Afropavo* from the typical pheasants seems questionable, particularly since some fairly detailed osteological studies by Lowe (1939) suggest strongly that it is simply a primitive or unspecialized type of peacock that is fairly closely related to both the Pavoninae and the Argusianinae. His inclusion of *Galloperdix* and *Ithaginis* in the Phasianinae is also noteworthy. In an earlier revision of the Galliformes, von Boetticher (1939) had divided the Phasianidae into nine subfamilies as follows:

Subfamily Odontophorinae

Subfamily Tetraoninae

Subfamily Lerwinae

Subfamily Perdicinae (Including *Ithaginis*)

Subfamily Tragopaninae (*Tragopan* only)

Subfamily Phasianinae (genera other than those listed separately)

Subfamily Pavoninae (including *Afropavo*, *Chalcurus*, *Polyplectron*, *Rheinartia*, *Argusianus*, and *Pavo*)

Subfamily Numidinae

Subfamily Meleagrinae

On the basis of immunological evidence, Mainardi (1963) suggested that, among the pheasants, *Gallus* has probably been evolved from early *Phasianus* like stock, and that both *Pavo* and *Afropavo* are closely related to primitive Phasianidae stock not very different from present-day guinea-fowl. He also suggested that the phasianids, cracids, and megapodes are all fairly closely related and were derived from this common ancestral stock.

In a major view of avian taxonomy, Sibley and Ahlquist (1972) provided egg-white evidence derived from electrophoretic studies, and concluded that variations in protein mobility made taxonomic interpretation difficult within the family Phasianidae. However, they noted that a very similar electrophoretic pattern exists between *Coturnix* and *Phasianus* as well as other pheasant genera, thus conflicting with earlier biochemical and anatomical evidence suggesting rather distant relationships between them. On the other hand, *Perdix* exhibited a noticeably compressed electrophoretic pattern. Their suggested classification of the pheasant group was to distinguish the typical pheasants (11 genera and 20 species were studied) from the Old World partridges as separate subfamilies (Phasianinae and Perdicinae), but they suggested that additional studies would be needed to establish relationships among the genera of these groups.

Beyond the still-unresolved question of how best taxonomically to recognize the pheasants as distinct from the Old World partridges and their relatives, there are a number of unsolved problems concerning larger taxonomic groupings within the Galliformes. This general question has been reviewed earlier (Johnsgard 1973, 1983b), and has also been very thoroughly discussed by Sibley and Ahlquist (1972). There is thus little purpose served in repeating these arguments, but a comparison of some representative classifications of the Galliformes might be presented to indicate the kinds of variations in proposals made within the past half-century (Table 1). As may be seen, there is general agreement that the megapodes (Megapodidae) and cracids (Cracidae) each deserve familial recognition. Both are seemingly derived from early, generalized galliform stock, although Clark (1964) believes that some of

**Table 1.** Some suggested classifications of Recent Galliformes (exclusive of *Opisthocomus*)

Peters 1934	Mayr and Amadon 1951	Verheyen 1956	Wetmore 1960	Johnsgard 1973
Megapodidae	Megapodidae	Megapodidae	Superfamily Cracoidea	Superfamily Cracoidea
Cracidae	Cracidae	Cracidae	Megapodiidae	Megapodiidae (10 spp.)
Tetraonidae	Phasianidae	Phasianidae	Cracidae	Cracidae (38 spp.)
Phasianidae	Phasianinae	Numidinae	Superfamily Phasianoidea	Superfamily Phasianoidea
Odontophorinae	Numidinae	Afropavinae	Tetraonidae	Phasianidae
Phasianinae	Tetraoninae	Meleagrinninae	Phasianidae	Meleagrinnidae (2 spp.)
Numididae	Meleagrididae	Tetraoninae	Numididae	Tetraoninae (16 spp.)
Meleagrididae		Perdicinae	Meleagrididae	Odontophorinae (30 spp.)
		Odontophorini		Phasianinae
		Coturnicini		Perdicini (103 spp.)
		Perdicini		Phasianini (49 spp.)
		Phasianinae		Numidinae (7 spp.)
		Pavoninae		
Total families 6	5	3	6	3
Total genera 93	—	—	—	—
Total species 267	240	—	—	245

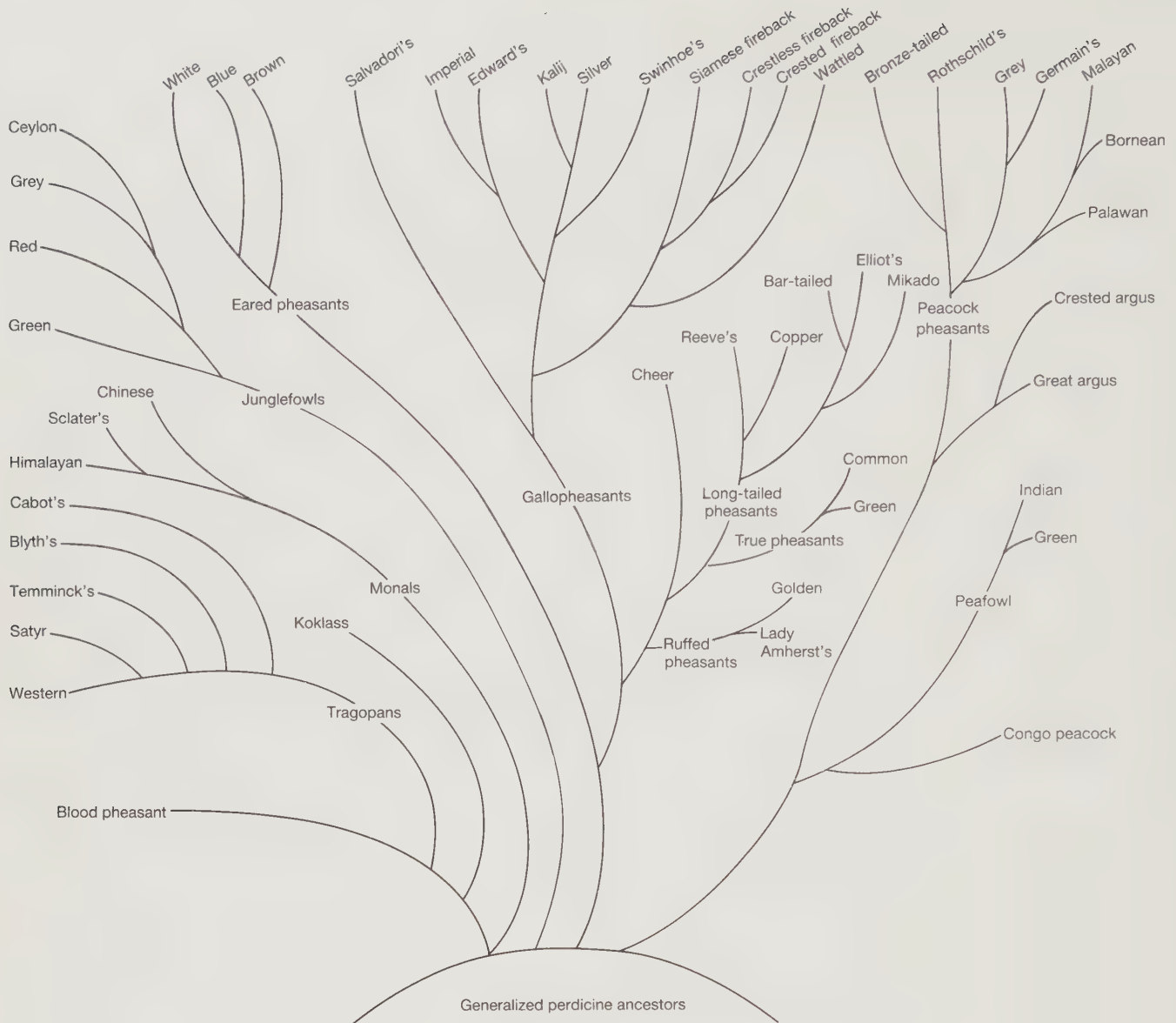
the megapodes' 'primitive' features are secondarily evolved. The grouse, although often given familial status in earlier classifications, are now generally thought to deserve no more than subfamilial separation from the pheasants (Johnsgard 1983b). The turkeys (Meleagrididae of Peters) and New World quails (Odontophorinae of Peters) have been treated very variably, but they too are now frequently recognized only as distinct subfamilies or, in the case of the New World quails, sometimes given no more than tribal distinction. Similarly, the guineafowl (Numididae of Peters) have usually been considered a full family, or at least a distinct subfamily, in most recent classifications, and their relationships to the more typical pheasants seem to be uncertain at present, the group perhaps having evolved from an early francolin-like precursor (Crowe 1978). Cracraft (1981) suggested that the guineafowl are the sister-group of the pheasants, grouse, turkeys, and New World quails, and considered them a separate family ('subfamily' in text) to the Phasianidae, which included all these other groups. However, Wolters (1975–1982) considered the guineafowl to be but one of 15 subfamilies of the Phasianidae, and the typical pheasants were divided into eight separate subfamilies.

### Generic and Species Limits

Like most groups of birds, the classification of the pheasants has tended to become modified in recent decades as ideas on the conceptual basis of the generic and species categories have undergone change, and as new information on range limits and geographic variation have become available. Using Elliot's (1872) monograph as a starting point, some

17 genera and 77 species were recognized by him. Similarly, Ogilvie-Grant's 1893 catalogue of the then-known pheasant species included 17 genera and 77 species. Beebe (1918–1922) recognized a total of 19 genera (excluding the then undiscovered *Afropavo*) and 61 species. Similarly, Peters (1934) recognized 21 pheasant genera (still exclusive of *Afropavo*), but only 49 species. Delacour (1977) likewise recognized 49 species (although not exactly the same as those of Peters), but accepted only 16 genera. Thus, in approximately a century, the number of recognized genera has ranged from 16 to 21, and the species from 49 to 77. However, as the number of recognized species has tended to decline with time, the number of described subspecies has increased, reaching a maximum of 124 in Delacour's most recent (1977) summary. Like Delacour, I have accepted 49 species. However, he regards the perplexing and fragmental specimen (a single feather) of *Argusianus bipunctatus* as a full species, but I believe that, given the available information, it should be considered no more than a subspecies. On the other hand, I regard the distinctive Bornean peacock pheasant (*schleiermacheri*) as a full species, as did Beebe, while Delacour considers it only a subspecies of *malacense*. I have generally followed Delacour's sequence of genera, except for his placement of the genus *Crossoptilon*, and my sequence of species within genera also varies but little from that used by Delacour. An evolutionary dendrogram (Fig. 1) is provided that indicates my interpretation of phyletic relationships of genera and species within the pheasant group, while a similar one (Fig. 2) is intended to show more general relationships of the pheasants within the Galliformes, based on my own interpretation of the available information.



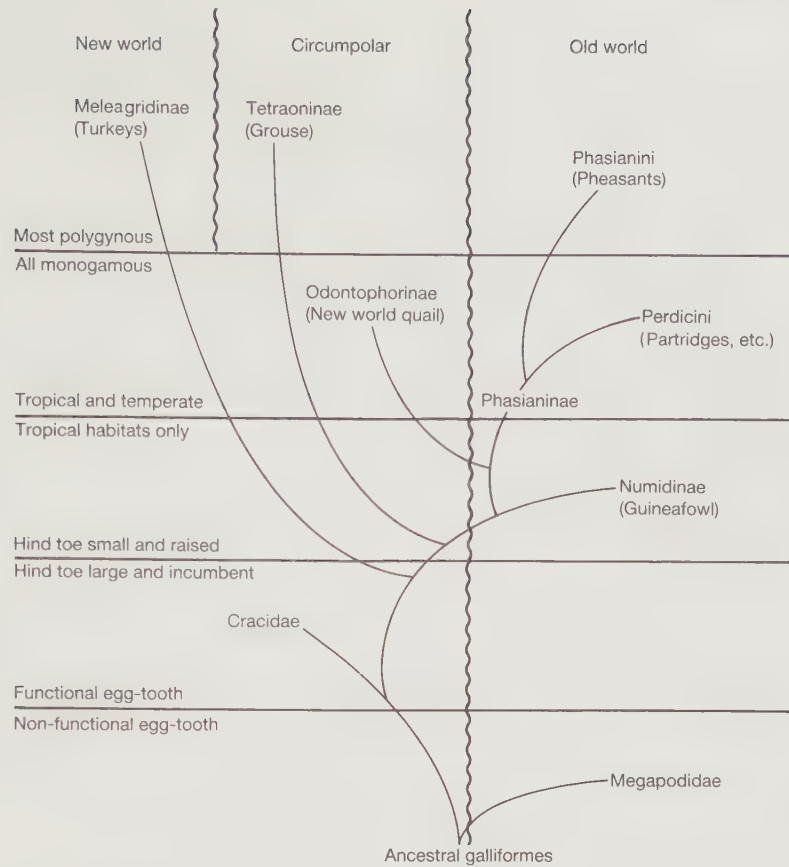


**Fig. 1.** Dendrogram of postulated evolutionary relationships among the species of pheasants.

A comparative summary of major anatomical and physiological or behavioural traits that seem to provide useful criteria for separating the pheasants from their seemingly nearest relatives is provided in Table 2. Most of these criteria are self-explanatory, but details of the behavioural traits will be discussed later in the book. It seems clear that there are so

many overlapping character traits between the pheasants and the Old World partridges that they should be regarded as no more than tribally separated. However, as will be made clear in the hybridization section, surprisingly few incidences of intergroup hybridization have been documented between the pheasants and Old World partridges.





**Fig. 2.** Dendrogram of postulated general relationships among the Galliformes, with ecological, structural, and distributional information superimposed.

**Table 2.** Comparison of major subgroups of the Phasianidae

	Tetraoninae	Odontophorinae	Phasianinae	
			Perdicini	Phasianini
Distribution	Holarctic	New World	Old World	Old World
Rectrices	16–22	10–14	8–22	14–32
Usual tail molt	Centripetal	Centrifugal	Centrifugal	Centripetal
Lower mandible	Smooth	Toothed	Smooth	Smooth
Nostrils	Feathered	Bare	Bare	Bare
Feathered tarsus	Yes	None	Rare (1 sp.)	None
Pectinated toes	Yes	None	None	None
Tarsal spurs	None	None	Few	Most
Usual pair bond	Polygynous	Monogamous	Monogamous	Polygynous
Sexual dimorphism	Variable	Slight	Slight	Variable
Postjuvinal primary molt	Incomplete	Incomplete	Incomplete	Variable
Sexual maturity	1 year	1 year	1 year	1–3 years
Average clutch size	5–12 eggs	10–15 eggs	4–16 eggs	1–12 eggs
Incubation period	21–27 days	22–30 days	16–25 days	18–29 days
Tidbitting display	No	Yes	Yes	Yes
Waltzing display	No	No	Yes	Yes

## 2 · Hybridization and zoogeographic patterns

Hybridization among the pheasants of the world has occurred under a variety of circumstances. In some instances it has resulted under natural conditions, as for example between such locally sympatric species pairs as the kalij (*Lophura leucomelana*) and the silver pheasant (*L. nycthemera*). In most cases it has occurred 'accidentally' among captive birds, especially when conspecific mates have been unavailable. Only in rare instances has it been specifically planned as part of an experimental programme of hybridization for scientific purposes, such as for obtaining genetic, morphological, or biochemical data associated with hybridization. Some of these latter studies have not provided information of general interest to most ornithologists, but instead have involved such biochemical information as hybrid haemoglobins (Brush 1967), transferins (Crozier 1967), or immunoelectrophoretic comparisons of blood sera (Sato, Ishi, and Hirai 1967).

The total literature concerning pheasant hybridization is thus very great, and has been admirably summarized by Gray (1958). Gray's review has provided the primary foundation for much of my own following summary, but has been supplemented by additional more recent information such as that provided by Delacour (1977), and Rutgers and Norris (1970). Some of the alleged hybrids mentioned by these authors have never been fully documented, and in a few cases such as a supposed hybrid between domestic fowl (*Gallus gallus*) and the lyrebird (*Menura novaehollandiae*) are sufficiently unlikely as to warrant discounting. Even by limiting the reported hybrids to those involving only members of the Galliformes there are some cases that strain credulity. Thus, the primary emphasis in this review will be on intra-tribal hybrids. However, a brief survey of reputed examples of hybridization between pheasants and species representing other tribes, subfamilies of the Galliformes seems warranted.

### Extra-tribal hybridization

Included in this category are all hybrids between pheasants and other major taxonomic groups of the

Galliformes. In all cases except those specifically noted, citations for their occurrence can be located in the reference by Gray (1958).

### *Phasianini* × *Perdicini*

The pheasants and Old World partridges and their relatives are generally considered to be fairly closely related, and in most classifications are included as members of the same subfamily (Phasianinae). Thus, one would expect a substantial number of hybrid records to have accrued between these two groups. Such, however, is not the case, and Gray lists only three such combinations. These include crosses of *Gallus gallus* (*G. 'domesticus'* according to Gray) with *Alectoris graeca* and *Perdix perdix*, and one between *Phasianus colchicus* and *Perdix perdix*. These were all presumed hybrids; none was produced under controlled conditions. Likewise, none was proven to be fertile, although one of the presumed *Gallus* × *Perdix* hybrid males exhibited the sexual behaviour of a 'normal' domestic fowl.

### *Phasianini* × *Tetraoninae*

By far the largest number of extra-tribal hybrid records involving pheasants have implicated various species of grouse. Except for an alleged but seemingly unlikely hybrid reported between a black grouse (*Tetrao tetrix*) and a silver pheasant, all have involved the domestic fowl or the common pheasant. Thus, domestic fowl have reportedly been hybridized with the ruffed grouse (*Bonasa umbellus*), hazel grouse (*Bonasa bonasia*) and willow ptarmigan (*Lagopus lagopus*, including *L. l. scoticus*), while pheasants have allegedly hybridized with ruffed grouse, pinnated grouse (*Tympanuchus cupido*), capercaillie (*Tetrao urogallus*), black grouse, rock ptarmigan (*Lagopus mutus*), red grouse (*Lagopus l. scoticus*), and blue grouse (*Dendragapus obscurus*). Unlikely as some of these combinations might seem there is little doubt that at least some of them have occurred repeatedly. Thus, Boback and Müller-Schwarze (1968) provided a photograph of a hybrid pheasant × black grouse, and stated that at least 15 such specimens were reported between 1833 and 1854.

Likewise, Jewett (1932) and Hudson (1955) described a total of five apparently natural hybrids between pheasants and blue grouse, and this combination was originally described late in the 19th century (Anthony 1899). There is no indication that any grouse  $\times$  pheasant hybrids have proven fertile, nor have any even shown any signs of sexual activity. Probably the relatively promiscuous mating systems of most grouse as well as of pheasants and domestic fowl have facilitated this high incidence of inter-tribal hybridization.

#### *Phasianini $\times$ Numidinae*

Crosses between pheasants and guineafowl, although unlikely, have been unquestionably obtained. Thus, domestic fowl have reputedly been hybridized with both the vulturine guineafowl (*Acryllium vulturinum*) and the domestic guineafowl (*Numida meleagris*), according to Gray (1958). The latter cross has also been studied biochemically by Crozier (1967), as well as by Sato *et al.* (1967). Similarly, presumed hybrids between common pheasants and domestic guineafowl have been reported, and hybrids have been produced repeatedly between the Indian peafowl and domestic guineafowl. Hanebrinck (1973) has recently described the morphology and behaviour of this combination. A fifth hybrid combination between pheasants and guineafowl is a reported cross between the Cabot's tragopan and the mitred guineafowl (*Numida mitrata*) which, like the other pheasant  $\times$  guineafowl hybrids, appears to have been completely sterile.

#### *Phasianini $\times$ Meleagridinae*

Pheasant  $\times$  turkey hybrids have also undoubtedly been produced on various occasions in captivity. Thus, there are several apparent hybrids known involving domestic fowl and domestic turkey (*Meleagris gallopavo*). Four hybrids were reportedly reared (out of a hatch of five) involving a domestic turkey and a peahen. Reciprocal crosses have also been obtained by artificial insemination between common pheasants and domestic turkeys (Asmundson and Lorenz 1975). Birds obtained by this method have been found to be completely sterile. Presumed 'natural' hybrids of this combination have also been reported occasionally.

#### *Phasianini $\times$ Cracidae*

Some rather dubious crosses between domestic fowl and various cracids have also been reported (Gray 1958). Thus, there is an alleged early case of apparent hybridization between a male curassow (*Crax* sp.) and a female domestic fowl, another similar case of a male *Crax alberti* hybridizing with a female

domestic fowl, and a third presumed case of hybridization between the domestic fowl and a guan (*Penelope* sp.). None of these cases was sufficiently well documented as to be accepted without additional proof.

#### *Phasianini $\times$ Megapodidae*

The only case of this highly unlikely cross was a reported example of hybridization between a male scrub turkey (*Alectura lathami*) and a domestic hen (G. A. Keartland, cited by Gray 1958). Three 'alleged' hybrids were reported, including a female that laid eggs that were 'not very large'.

#### *Summary of extra-tribal hybridization*

It may be seen that a rather surprising array of inter-tribal and even a few inter-familial hybrids have been reported, although all of the inter-familial combinations are sufficiently vague and unsupported as to probably be discounted. What is surprising is the absence of any reported hybrids between the pheasants and the New World quails (Odontophorinae). Even more surprisingly, there are also no reported crosses between the New World quails and the Old World partridges (Perdicini), in spite of many species of both groups having been bred regularly in captivity. This might support the idea that the New World quails deserve at least subfamilial separation from the rest of the Phasianidae, and may be no more closely related to the pheasants than are, for example, the grouse.

#### *Intra-tribal hybridization*

Hybridization within the pheasant tribe Phasianini is far more frequent than is inter-tribal hybridization, and offers a much greater amount of information of significance from a taxonomic and ecological perspective. The summary provided (Fig. 3) lists all of the species of pheasants that have been implicated in interspecific hybridization in the summaries of Gray (1958), Rutgers and Norris (1970), and Delacour (1977). The domestic fowl (*Gallus 'domesticus'*) is here considered conspecific with the red junglefowl (*G. gallus*).

Several interesting conclusions can be drawn from a study of this summary. The first is that fertility among intergeneric hybrids is relatively low, and is seemingly limited only to males when it does occur. Male fertility has thus been reported for intergeneric hybrids between *Lophura* and *Crossoptilon*, *Lophura* and *Syrmaticus*, *Lophura* and *Phasianus*, *Lophura* and *Chrysolophus*, *Catreus* and *Syrmaticus*, *Syrmaticus* and *Phasianus*, and *Phasianus* and *Chrysolophus*.



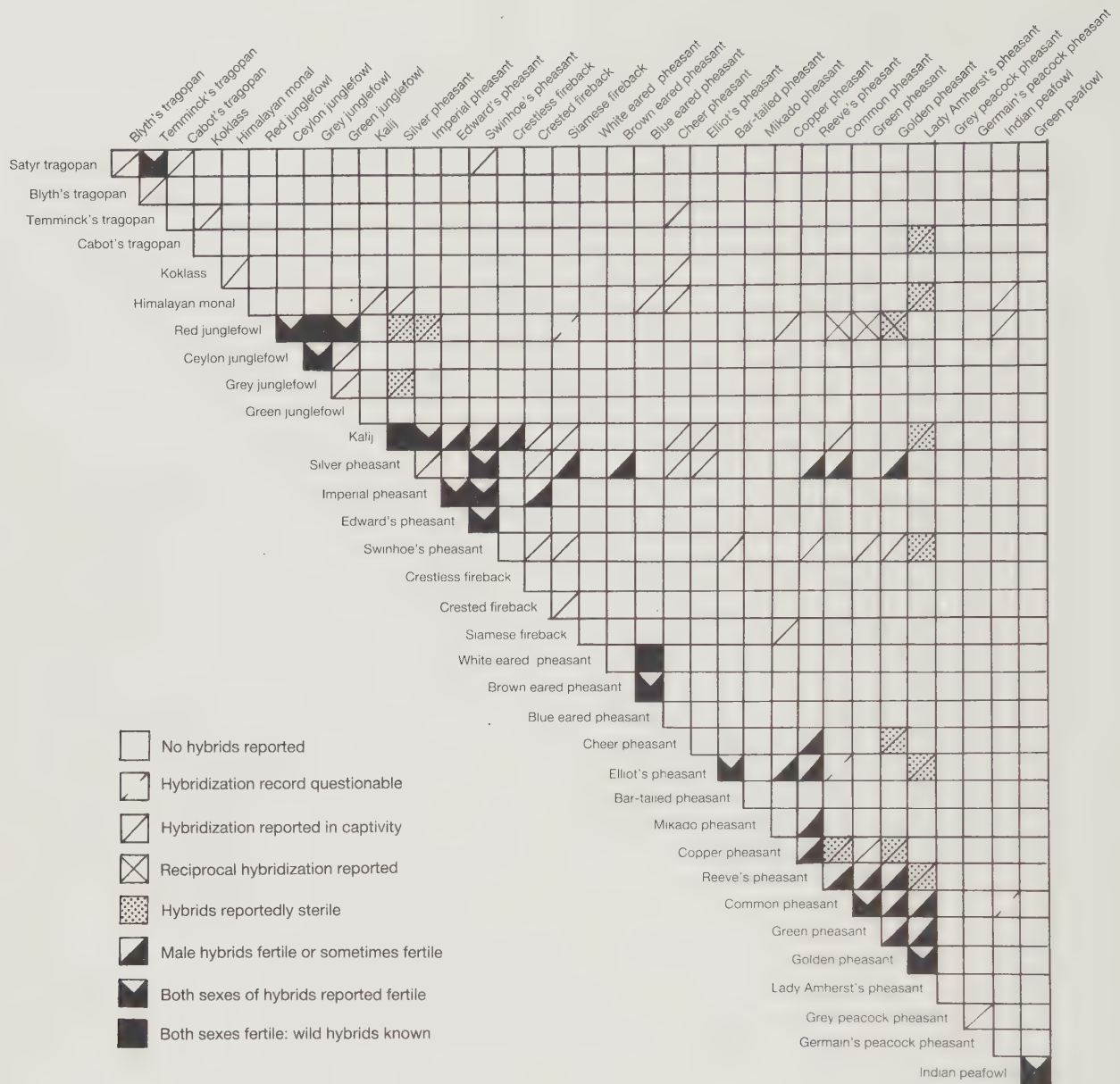


Fig. 3. Records of interspecific hybridization reported among the pheasants, based on available information through to 1982. See text of Bornean peacock pheasant for two additional records.

Fertility involving both sexes is apparently limited to intra-generic hybrids, such as those between species of *Tragopan*, *Gallus*, *Lophura*, *Crossoptilon*, *Symaticus*, *Phasianus*, *Chrysolophus*, and *Pavo*. There are evidently only three possible instances of natural hybridization under wild conditions so far known among pheasants. These involve the red and Sonnerat's junglefowls, the kalij and silver pheasants, and possibly the white and blue eared pheasants. Although white and blue eared pheasants have reportedly hybridized in the wild (Gray 1958), secondary contact is still uncertain.

The golden and Lady Amherst's pheasants are not yet known to exhibit secondary contact in the wild, but at least in captivity have no apparent barriers to hybridization and little evidence of reduced hybrid fertility in either sex (Phillips 1921; Danforth and Sandness 1939; Danforth 1950).

Another interesting point to be drawn from this table is that *Gallus* seems to exhibit no intergeneric hybrid fertility whatsoever, suggesting that it occupies a somewhat isolated position in the pheasant tribe. Furthermore, this observation casts further doubt on the authenticity of the alleged hybrid men-

tioned earlier between a domestic fowl and a scrub turkey that reportedly was a 'good layer'.

On the other hand, the genus *Lophura* would seem to occupy a relatively central position in the pheasant assemblage, with hybrid combinations extending on the one extreme to the genus *Tragopan*, and on the other to *Chrysolophus* and the other 'long-tailed' pheasant genera. The peafowl and peacock pheasants seem to be relatively isolated, however, with sterile hybrids being reported between *Pavo* and the genera *Gallus* and *Phasianus* (Gray 1958), as well as with *Lophophorus* (Delacour 1977). So far, hybridization involving the genus *Polyplectron* seems to be limited to crosses between the grey and Germain's peacock pheasants, the Rothschild's and grey peacock pheasant, and the Malayan and Bornean peacock pheasants. (Vernon Denton, in litt., not included in diagram). Genera that so far (as of the time of this writing in 1984) have not been reported involved in hybridization include *Ithaginis*, *Pucrasia*, *Rheinartia*, *Argusianus*, and *Afropavo*. Of these, all but *Pucrasia* are only rarely maintained and bred under captive conditions.

#### Summary of intra-tribal hybridization

Of the calculated 1166 mathematically possible interspecific crosses that are possible within the 49 species of Phasianini, a total of 93 have actually been reported to have occurred, or 8.0 per cent of the possible total. This compares with 15 of 120 total possible combinations (12.5 per cent) among the 16 species of grouse (Tetraoninae) as reported by Johnsgard (1982). Further, a total of 36 of the 49 pheasant species have been implicated in hybridization, or 73 per cent of the total tribe, while in the grouse subfamily 12 of 16 species, or 75 per cent, have been so implicated. Of the pheasant hybrids, 48 per cent have been intrageneric on the basis of current taxonomy and 52 per cent intergeneric, while 43 per cent (40 of 93) have been reported as being at least occasionally fertile. By comparison, 10 of the 15 known grouse combinations, or 67 per cent, are intergeneric by current taxonomic standards, and only 33 per cent intrageneric. Most of these latter hybrids were of wild birds, and thus their fertility is not generally known.

#### Distributional patterns

It is quite apparent that the entire subfamily Phasianinae (Perdicini and Phasianini as recognized here) is centred in the Oriental zoogeographic region. Except for the single anomalous case of *Afropavo* in Africa, all of the pheasants are limited to south-east Asia, roughly between the vicinity of the Black Sea on the west and Japan on the east, and extending northward as far as Mongolia, and south to the

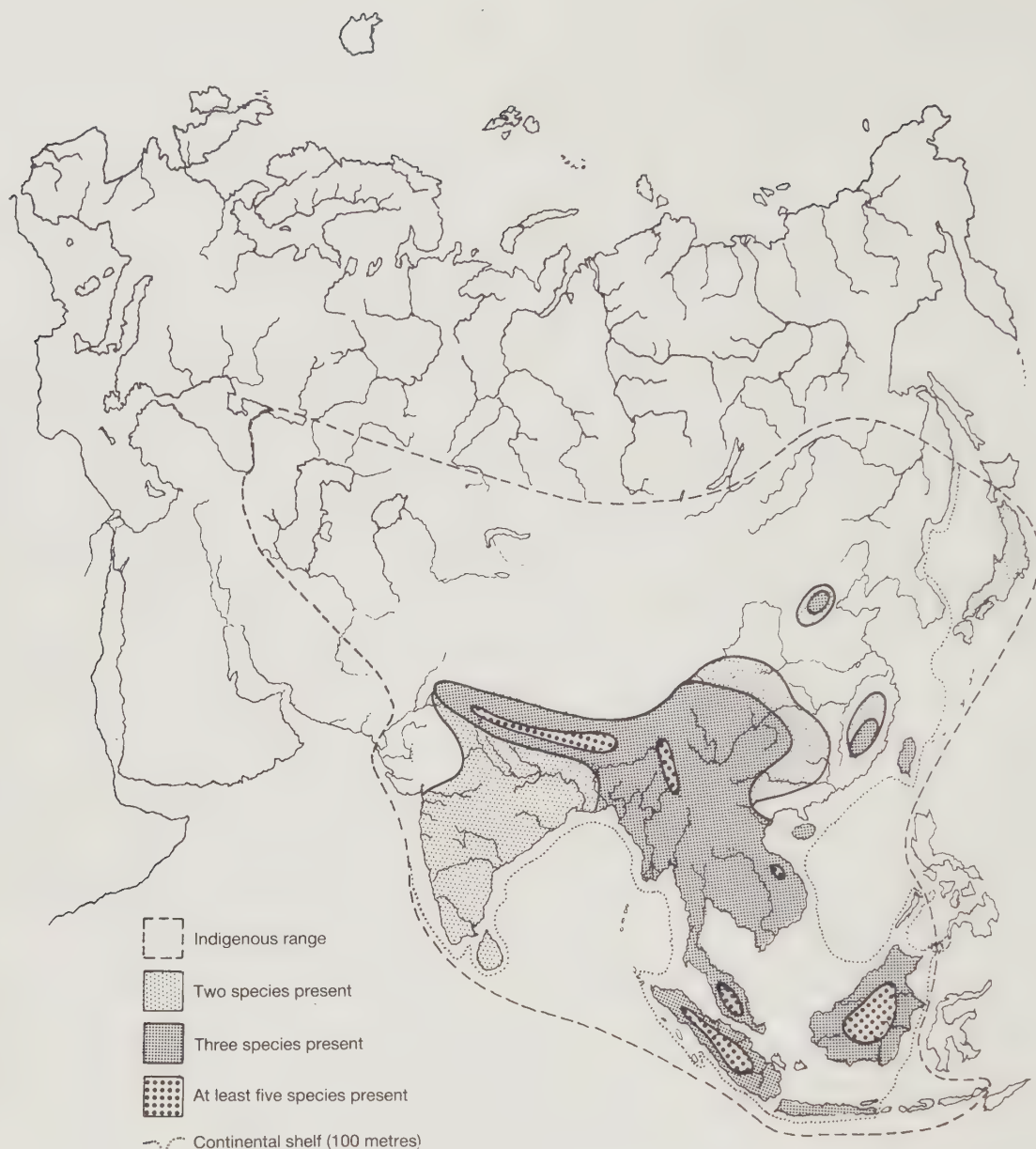
Lesser Sundas. If the collective native ranges of all the pheasants are plotted on a map (which is made somewhat difficult because of uncertainties as to the original range limits of *Phasianus colchicus* and *Gallus gallus*), this geographic relationship becomes very clear (Fig. 4). For example, some 45 species of Phasianinae (18 Phasianini and 27 Perdicini) out of an approximate world total of 174, or more than 25 per cent, are native to the Indian subcontinent (Ali and Ripley 1978). By comparison, sub-Saharan Africa has only a single species and genus of pheasant, but supports 40 additional species of Perdicini, nearly all of which are francolins (Snow 1968). The USSR supports six genera and 11 species of partridges, but has only a single species of pheasant (Dementiev and Gladkov 1967). Thus the Himalayan mountains and their associated deserts have evidently served as an effective barrier to northward expansion of the pheasants. The Himalayas themselves (as represented by Nepal) support 14 species of partridges and 8 species of pheasants (Fleming and Bagdel 1976). Likewise, Tibet supports 12 species of partridges and 10 pheasants (Vaurie 1972), and China has 22 species of partridges and 26 pheasants (Cheng *et al.* 1978). South-east Asia (Burma, Indochina, and the Malay Peninsula) holds a total of 8 genera and 16 species of partridges, as well as 13 genera and 23 species of pheasants, in an area somewhat smaller than that of the Indian subcontinent (King and Dickinson 1975). South-east Asia is thus relatively richer in pheasants than partridges, while Africa and south-west Asia are considerably richer in partridges than pheasants.

Beyond these overall range aspects, it is of interest to note areas that are high in species diversity of pheasants, based on available information on individual species' ranges (Fig. 4). It is apparent that several such areas, supporting five or more pheasant species, exist. The first and most extensive of these are the Himalayan mountains, where eight pheasant species occur. These include all of the most alpine-adapted and partridge-like of the pheasants, including the genera *Ithaginis*, *Tragopan*, and *Pucrasia* (Table 3).

A second centre of pheasant diversity occurs in the general vicinity of northern Burma and adjacent Yunnan, in the upper reaches of the Yangtze, Mekong, Salween, and Irrawaddy rivers. In these temperate-zone mountain valleys such essentially tropic-adapted genera as *Polyplectron* and *Pavo* exist in fairly close proximity to more montane-adapted types such as *Tragopan*, and a total of six pheasant species occur.

A third area of high species diversity and endemism occurs in Annam (now central Vietnam), which supports eight pheasant species, including two





**Fig. 4.** Species-density map of pheasants in Asia. Broken line indicates overall indigenous Asian range of pheasants; dotted line shows limits of continental shelf (Sunda platform) in this region.

(*Lophura imperialis* and *L. edwardsi*) whose ranges apparently are the most limited of any mainland pheasant species. Delacour (1977) considered their closest living relative to be the Swinhoe's pheasant but zoogeographically it would seem more probable that they are offshoots of a generalized mainland kalij-like ancestor.

The Malay Peninsula, from southern Burma (Tenasserim) southward, represents an area of pheasant diversity that matches that of the central Himalayas. It supports eight native pheasant species,

including one endemic (*Polyplectron inopinatum*) and one species shared only with Sumatra (*Polyplectron malacense*). This area would seem to be the centre of evolutionary diversity of the highly specialized peacock-like pheasants (*Pavo*, *Argusianus*, *Rheinartia* and *Polyplectron*), in the same way that the Himalayas obviously have served as the ancestral home of the more partridge-like genera. The presence of an archipelago situation (Greater and Lesser Sundas plus Borneo) has probably facilitated speciation in this area. Both Borneo and Suma-

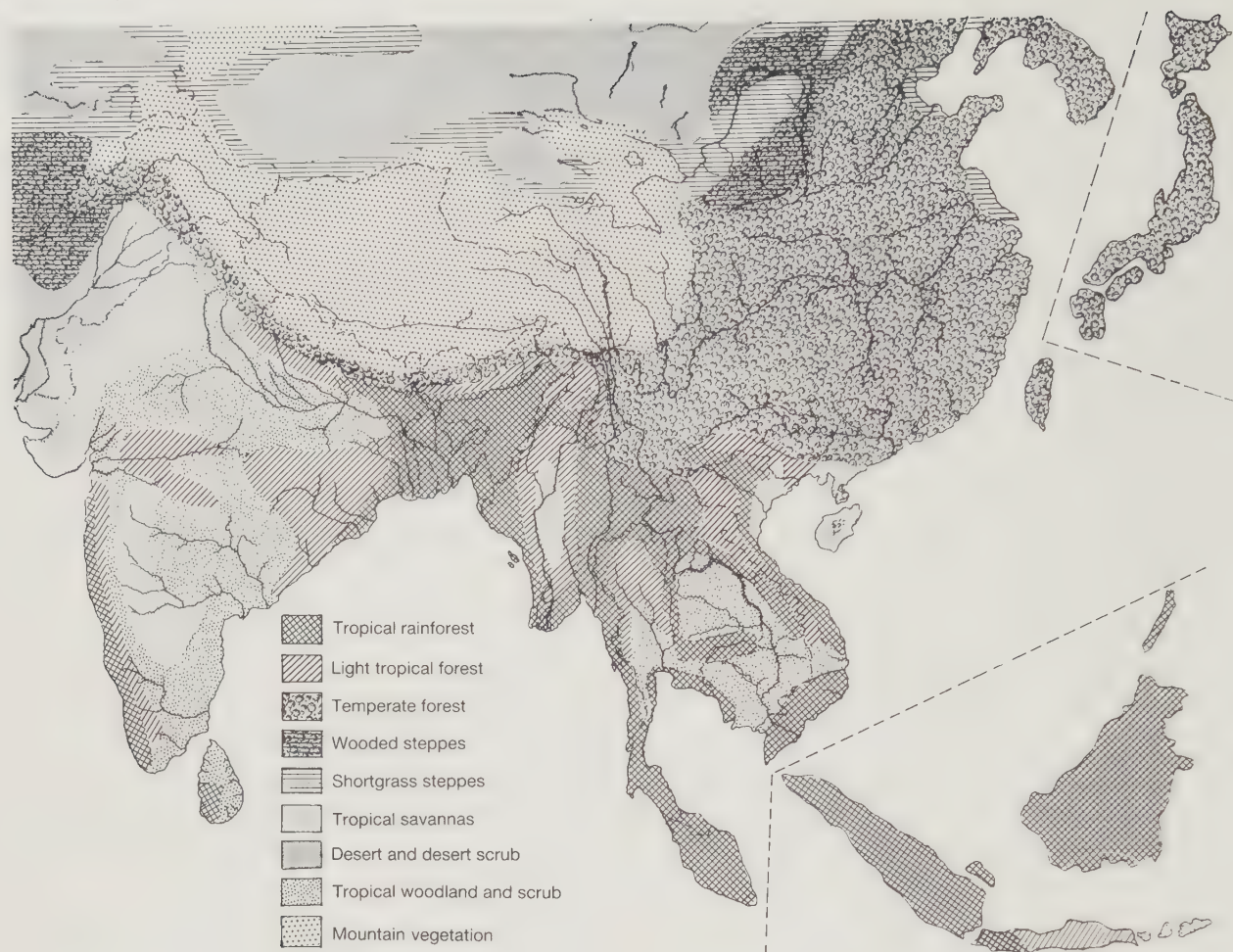
**Table 3.** Ecological distribution of pheasants in selected areas of high species density in Asia

	High montane forests	Mid-montane forests	Lowland forests
Central Himalayas	Blood pheasant Impeyan	Koklass Cheer pheasant Satyr tragopan Kalij	Indian peafowl Red junglefowl
Upper Burma/Yunnan		Kalij Bar-tailed pheasant Blyth's tragopan	Red junglefowl Grey peacock pheasant Green peafowl
Annam (Vietnam)		Silver pheasant Imperial pheasant	Edward's pheasant Red junglefowl Siamese fireback Grey peacock pheasant Green peafowl Crested argus
Malay Peninsula		Rothschild's peacock pheasant	Malayan peacock pheasant Red junglefowl Great argus Crested argus Green peafowl Crested fireback Crestless fireback
Sumatra		Bronze-tailed peacock pheasant Salvadori's pheasant	Great argus Crested argus Crestless fireback Red junglefowl Malayan peacock pheasant
Borneo			Great argus Crested fireback Crestless fireback Bornean peacock pheasant Wattled pheasant

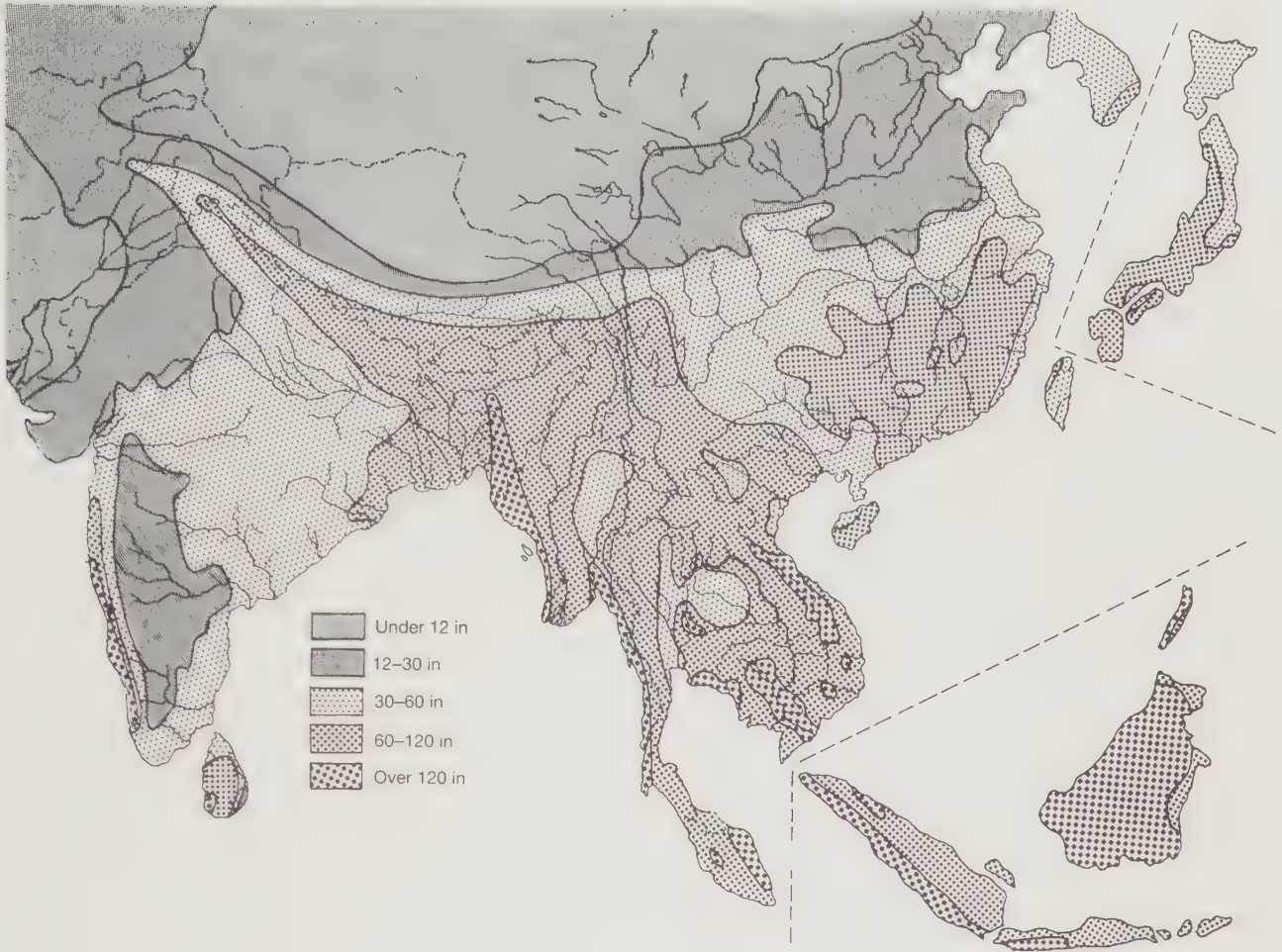
tra thus qualify as major centres of species diversity in pheasants, supporting seven and five species respectively. Sumatra's pheasant fauna includes two endemics (*Polyplectron chalcureum* and *Lophura salvadori*), and Borneo likewise supports two endemics (*Lophura bulweri* and *Polyplectron schleiermacheri*, the latter considered by Delacour as only subspecifically differentiated). This general region of Indonesia from Malaya to Borneo also supports several endemic and distinctive genera of *Perdicini* (*Haemator-tyx*, *Caloperdix*, *Rhizothera*, *Melanoperdix*), further attesting to its importance as a centre of phasianine evolutionary diversity. This entire region lies within the continental shelf of Asia (the Sunda Platform), and in general is separated from the mainland of Asia by current water depths of considerably less than 300 m. Assuming that ocean levels during periods of maximum glaciation were at least 200 m lower than current ones, virtually all of the current collective Asian pheasant range would fall within the area then part of the Asian mainland, including

the islands of Ceylon, Taiwan, the Greater Sundas (excepting the Celebes), and Palawan Island. Interestingly, Wallace's line (between Borneo and the Celebes) rather effectively separates the distribution patterns of the pheasants and the megapodes, which reach the coastal islands of Borneo and extend from there throughout much of the Australian region (Olson 1980). Finally comparison of Fig. 5 with similar maps showing natural vegetation patterns and annual precipitation patterns further indicate that the richest areas of current pheasant species densities are those having at least 60 in. of rainfall and regions that are at least partially wooded with temperate montane to tropical forests (Figs. 6–8). It seems probable that the singular distributional anomaly of the African peafowl in the Congo basin of Africa can be explained on the basis of isolation of a pre-*Afropavo* form in south-west Europe during Miocene times, after which it was driven south into west Africa during the onset of colder periods in Europe (Lowe 1939).

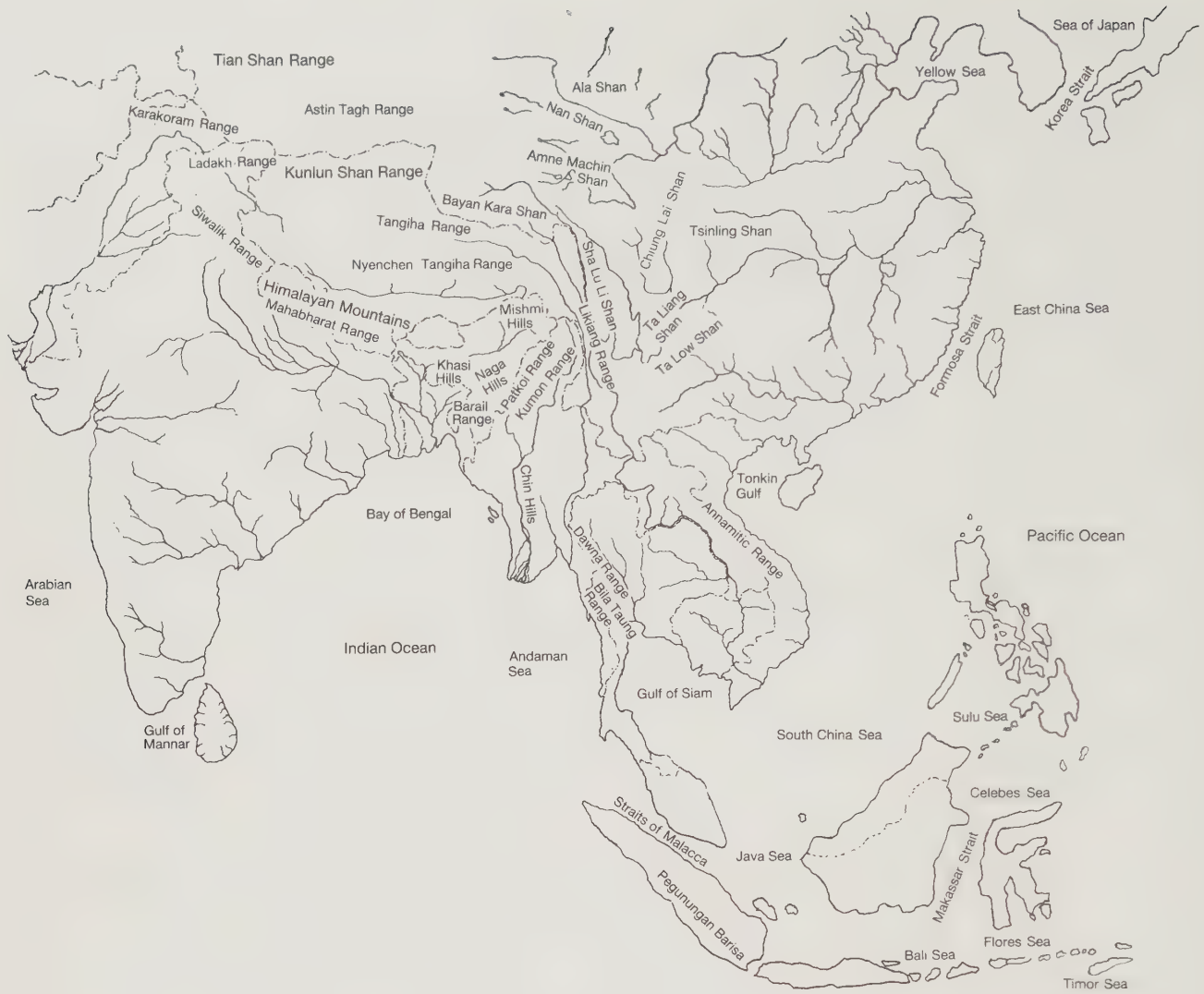




**Fig. 5.** Distribution of native vegetation types in south-east Asia. Adapted from a map in the *Hammond Contemporary World Atlas*.

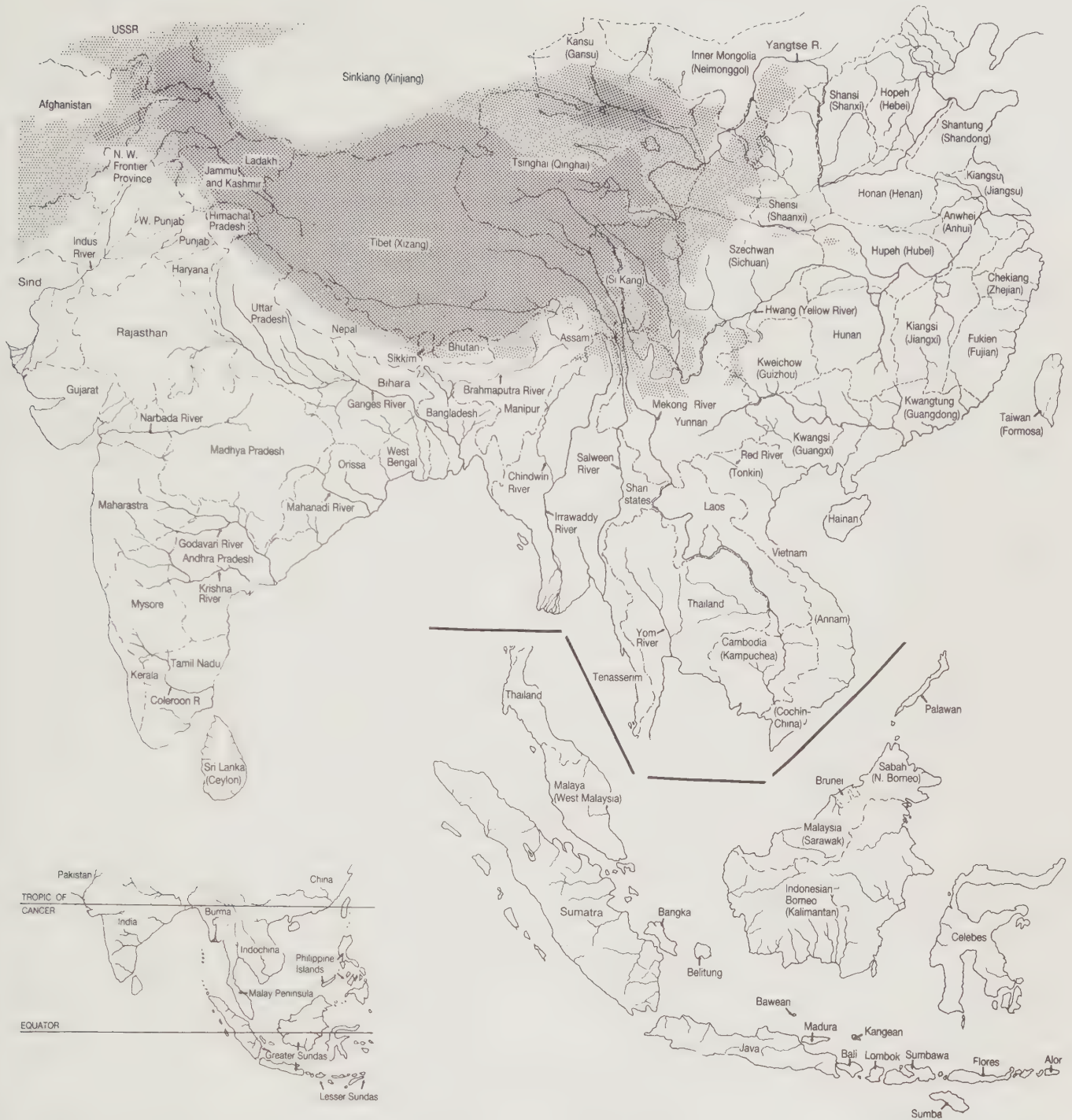


**Fig. 6.** Distribution of annual precipitation patterns in south-east Asia. Adapted from a map in *The Times Atlas of the World*.



**Fig. 7.** Distribution of river drainages, mountain ranges, and various oceanic features in south-east Asia.





**Fig. 8.** Map of south-east Asia, showing various localities and elevations, with light shading indicating land areas above 6000 ft., and heavier shading those above 12 000 ft.



# 3 · Growth and behavioural development

## Moult and plumages

The galliform pattern of moult and plumage development has been reviewed in detail with particular reference to grouse and quails (Johnsgard 1973, 1983*b*), and inasmuch as pheasant plumage development closely follows the same sequence there is little purpose served in repeating all this information. However, the consistent pattern of growth and moulting of the primary feathers has been a major basis for judging ages of pheasants by wildlife biologists, so it is appropriate that at least this aspect of plumage ontogeny be reviewed. Although early work by Juhn (1938) on the domestic fowl provided the basic understanding of juvenile moulting patterns in the Phasianidae, Buss (1946) was the first person to develop a method of aging young ring-necked pheasants on the basis of growth and moulting patterns of their primary feathers, and his methods were later amplified and modified by a variety of workers (Trautman 1950; Westerskov 1957; Etter, Warnock, and Joselyn 1970, and others). More recently, similar moult studies were performed using Reeves' pheasants (Mueller and Seibert 1966), and work on the ring-necked pheasant has been expanded to include the moulting patterns of all of the remiges and their coverts (Sutter 1971). Felix (1964) has provided some data on moulting patterns in the eared pheasants, and Durrer (1965) has analyzed the growth and microscopic structure of the 'eye' feathers of the male peafowl. Bura (1967) has performed a similar study of the juvenile and first-winter plumages of the common pheasant.

### *Juvenal plumage*

Although pheasants are covered in a downy (natal) plumage at the time of hatching, in many species at least they already at that stage exhibit several feathers associated with the subsequent juvenal plumage, including the first seven primaries and the third through eleventh secondaries (Sutter 1971). Similarly, in the Reeves' pheasant the first seven primaries are present at hatching. The remaining three juvenal primaries appear over the next three to four weeks. Growth in all these primaries occurs in an orderly, sequential fashion from the wrist outwards, and in the secondaries from the third secondary both

inwardly and outwardly (Table 4). The alular feathers also develop from the shorter ones to the longest, and both the major upper wing-coverts and under wing-coverts follow a sequence very similar to their corresponding remiges. Moult patterns of the lesser primary coverts are more complex and individually variable than are those of the major coverts (Sutter 1971). Juvenal primary growth and moult in the Reeves' pheasant follows a very similar pattern (Table 5).

Growth and moult of the rectrices follow a somewhat different pattern, judging from limited observations on the Reeves' pheasant. In that species none of the rectrices is present at hatching, but in one study they appeared during the twelfth day in both sexes. All of the juvenal rectrices completed their growth between 40 and 60 days after hatching, and were moulted almost immediately thereafter. The second (from the middle) rectrix moulted first, and moult proceeded in a generally centrifugal pattern, with the outermost (ninth) rectrix moulting on the 70th day after hatching (Mueller and Seibert 1966).

### *First winter plumage*

The juvenal wing plumage is lost during the postjuvenal moult, which in the ring-necked pheasant begins at the age of 23 days, with the appearance of the second (the first is rudimentary) alula quill, and proceeds next with the first primary (27 days) and greater secondary coverts (29 days). It terminates with the replacement of the lesser primary coverts and the innermost of the greater under secondary coverts at four to five months of age. The sequence of growth of the primaries and secondaries themselves follows a very similar pattern to those of the juvenal plumage (Table 6), starting with the first primary and the third secondary, and ending with the outermost primary and innermost (15–17th) group of secondaries. Feather growth is virtually completed by the age of 150 days in the primaries and secondaries, and by 170 days in the greater under secondary coverts. The remiges of the first winter plumage grow considerably more rapidly than do those of the juvenal plumage and at a more constant maximum rate, of up to about 7 mm daily

Table 4. Average juvenal flight feather development in the ring-necked pheasant<sup>1</sup>

		Age of emergence	Period of growth days <sup>1</sup>		Final feather length (mm)	
			Males	Females	Males	Females
Primary No.	10	17.6	41.5	37.9	131	119
	9	11.5	40.0	38.1	137	129
	8	5.8	38.7	36.2	131	124
	7	†	36.7	35.2	123	118
	6	†	31.9	30.5	117	112
	5	†	28.1	26.8	109	107
	4	†	24.1	23.0	98	94
	3	†	19.9	10.1	85	82
	2	†	16.1	15.6	72	70
	1	†	13.7	12.8	61	58
Secondary No.	1	13.3	25.7	25.4	97	89
	2	9.0	28.7	27.4	111	104
	3	†	18.2	18.2	74	71
	4	†	20.5	21.1	81	79
	5	†	—	—	—	—
	6	†	29.9	23.8	91	89
	7	†	—	—	—	—
	8	†	29.9	28.8	100	98
	9	†	—	—	—	—
	10	†	35.2	33.5	110	105
	11	†	—	—	—	—
	12	2.2	41.1	37.5	121	110
	13	6.3	—	—	—	—
	14	11.7	42.8	40.1	113	106
	15	17.3	—	—	—	—
	16	21.0	39.7	34.8	90	79
	17	23.4	37.0	32.3	76	68

<sup>1</sup> After Sutter 1971.

† Featherless.

in both primaries and secondaries. Sexual dimorphism is also less marked in the first feather generation than in later ones (Sutter 1971).

The post-juvenal moult of the rectrices is apparently considerably different from the post-natal moult, at least in the Reeves' pheasant. All the rectrices of the first-winter plumage appear between the 50th and 70th days in both sexes, and in this species the central pair of rectrices are much the longest, while the ninth pair are the shortest. Although the exact order of moult has not been determined, the general pattern of the moult is clearly centripetal, beginning with the outer rectrices and proceeding centrally (Mueller and Seibert 1966).

In the blue eared pheasant the postjuvenal tail moult apparently proceeds in a generally centripetal direction, although it begins at about 30 days with the pair on either side of the uropygial gland (Felix 1964). The last to emerge is the tenth (third from innermost), and the innermost three pairs of feathers

are not fully grown until the bird is about 140 days old. (The brown and white eared pheasants, with fewer rectrices, exhibit slightly different tail moulting patterns that are neither strictly centripetal nor centrifugal.) At about the same time the innermost (13th) secondary has completed its growth, but the two outermost secondaries and the ninth primary do not complete their growth until the bird is about 180 days old. The juvenal tenth primary is retained in eared pheasants throughout the first winter, according to Felix.

On the basis of these and similar studies, it is possible to estimate easily the age of young ring-necked pheasants from their first to at least their 24th week of life (Table 7). Such information is extremely useful in estimating hatching dates in wild populations. Differences in the shape and colour of the outer greater secondary coverts are also useful in aging and sexing ring-necked pheasants (Fig. 9). Thus, in males the third to fifth of these

**Table 5.** Primary feather development rates in the Reeves' pheasant<sup>1</sup>

Primary No.	1	2	3	4	5	6	7	8	9	10
<i>Juvenal primaries</i>										
Average age at appearance (days)										
Both sexes	1	1	1	1	1	1	1	8	16	29
Average age when fully grown (days)										
Males	29	29	33	33	40	40	40	44	72	92
Females	27	29	35	39	36	38	44	47	73	91
Average length when fully grown (mm)										
Males	76	83	99	106	114	114	115	115	138	152
Females	68	75	90	102	109	109	113	114	130	131
<i>First winter primaries</i>										
Average age when fully grown (days)										
Males	69	74	84	96	110	123	128	149	168	— <sup>2</sup>
Females	58	66	75	87	102	118	125	139	162	—
Average length when fully grown (mm)										
Males	135	153	173	180	190	194	184	184	168	—
Females	121	141	154	160	169	171	172	161	152	—

<sup>1</sup> After Mueller and Seibert (1966).<sup>2</sup> Juvenal primary No. 10 retained throughout first year in this species.

coverts are less adult-like than are the first and second of these coverts, which are moulted later. In adult birds all five of these coverts are similar in shape and pattern (the third usually as long or longer than the second, as well as being broader and more strongly patterned). In females there is not such a striking contrast in pattern between the second and third coverts, although the third covert in adults is typically distinctly larger and broader than the second (Sutter 1971).

#### *Second winter plumage*

The first winter plumage is carried not only through the winter but also through part or all of the following breeding season, and is not obviously different from definitive adult plumages. In the Reeves' pheasant the first post-nuptial wing moult begins rather early in males, with the majority of them losing their first primaries by late April (in Ohio). Primary moult again follows a similar sequence, proceeding gradually to the outermost primaries, which are dropped by late August to early September. Females begin moulting their innermost primaries approximately two months later than males in mid-June, and proceed correspondingly outwardly, but at a more rapid rate, so that all of their primaries have

been dropped by late September, or only about two weeks later than males. The first male primaries of the second winter plumage appear (on average) in late April, and the first female primaries in early June. The outermost male primary appears in late August, and completes growth in only 15 days, while the average female date for the outermost primary is mid-September, and its growth is completed by mid-November. Moult in the male rectrices begins in May, with new feathers of the second winter plumage appearing between the end of May and early July, with the central rectrices appearing last. Similarly, the female rectrices appear between late June and early August, with rectrix growth being completed in females by late October and in males (with appreciably longer central tail feathers) by early December (Mueller and Seibert 1966).

In the ring-necked pheasant adult wing moult follows a similar pattern, with males beginning to moult their primaries a month earlier than females, and completing moult earlier as well. Adult moult onset in females seems to be correlated with the date of hatching of their broods, while in males its earlier timing is seemingly associated with an earlier fall gonadal development cycle (Kabat,



**Table 6.** Average first-winter flight feather development in the ring-necked pheasant<sup>1</sup>

			Period of growth (days)		Final feather length (mm)	
Age at emergence			Males	Females	Males	Females
Primary No.	10	110.7	37.1	33.7	160	140
	9	96.7	36.9	32.5	181	156
	8	79.6	35.5	32.0	187	163
	7	69.2	34.6	31.4	189	166
	6	60.7	34.1	30.5	190	167
	5	53.3	32.5	29.1	197	167
	4	45.7	31.1	28.1	181	164
	3	38.8	28.8	26.6	167	152
	2	32.3	27.6	25.0	153	139
	1	26.9	26.5	24.6	140	128
Secondary No.	1	102.9	21.1	20.9	100	91
	2	78.8	24.7	23.0	139	124
	3	36.6	25.3	23.8	137	126
	4	40.9	25.7	24.0	141	129
	5	46.1	— <sup>2</sup>	—	—	—
	6	50.6	26.1	24.2	145	131
	7	55.1	—	—	—	—
	8	59.1	27.3	24.7	149	133
	9	63.4	—	—	—	—
	10	67.4	28.7	26.6	156	138
	11	73.1	—	—	—	—
	12	79.6	30.7	28.7	159	139
	13	90.5	—	—	—	—
	14	104.2	31.7	29.4	128	110
	15	117.3	—	—	—	—
	16	122.8	30.2	29.8	96	87
	17	117.3	28.3	28.0	81	74

<sup>1</sup> After Sutter (1971)<sup>2</sup> Data not available

Thompson, and Kozlik 1950). In the eared pheasants males also typically begin to moult five to six weeks earlier than do females. In these, wing moult likewise begins with the innermost primary, the third secondary, and the outermost rectrix. Adult tail moult in the eared pheasants is evidently essentially centripetal (Felix 1964).

### Behavioural development

Much the most thorough review of the ontogenetic development of behaviour in any pheasant species is that of Kruijt (1964) for the Burmese red junglefowl, which may serve as a model for pheasants in general and is the primary basis for the following review. Non-social behaviour that is typical of galliform species from hatching or shortly thereafter includes locomotory behaviour (walking, running, jumping, hopping and flying), behaviour associated with feeding or drinking, defecation, and sleeping, and behav-

iour that can be conveniently labelled as 'comfort behaviour', and including such things as stretching, preening, dust-bathing, and the like.

Walking, running, jumping, and hopping all occur in junglefowl from shortly after hatching, or by no later than the third day. Hopping differs from jumping only in that it consists of a series of consecutive jumps, with the wings being flapped with each hop. Thus hopping gradually develops into flying behaviour, which in junglefowl begins on the 12th day, when the wing feathers have grown sufficiently to support the weight of the body. As the bird develops it gradually loses its dependence upon hopping as a precursor to flight.

Feeding behaviour develops around ground-pecking behaviour, which is present immediately after hatching. Newly hatched birds typically peck at any small spots that contrast with the background, particularly those objects that are relatively more rounded than angular in shape. Ground-scratching,



**Table 7.** Wing and tail criteria for aging young ring-necked pheasants<sup>1</sup>

Age (weeks)	Primary Number	Primary length range (mm)		Average tail length (mm) <sup>1</sup>
		Females	Males	
1	7 (juv.)	1-28	1-28	—
2	7 (juv.)	29-47	29-47	10 (both sexes) <sup>1</sup>
3	7 (juv.)	48-68	48-68	36 (both sexes) <sup>1</sup>
4	10 (juv.)	6-25	6-25	50 (both sexes) <sup>1</sup>
5	10 (juv.)	26-50	26-50	63 (both sexes) <sup>1</sup>
6	10 (juv.)	51-73	51-73	70 (both sexes)
7	3 (1st winter)	30-80	33-81	76 (males) <sup>1</sup>
8	5 (1st winter)	0-36	0-37	89 (males) <sup>1</sup>
9	6 (1st winter)	0-28	0-31	101 (males) <sup>1</sup>
10	7 (1st winter)	0-14	0-24	101 (males) <sup>1</sup>
11	8 (1st winter)	0-14	0-5	140 (males) <sup>1</sup>
12	8 (1st winter)	15-44	6-47	165 (males) <sup>1</sup>
13	9 (1st winter)	0-14	0-4	203 (males) <sup>1</sup>
14	9 (1st winter)	15-38	5-36	241 (males) <sup>1</sup>
15	10 (1st winter)	0-16	0-9	279 (males) <sup>1</sup>
16	10 (1st winter)	17-48	10-49	292 (males) <sup>1</sup>
17	10 (1st winter)	49-77	50-82	305 (males) <sup>1</sup>
18	10 (1st winter)	78-101	83-107	330 (males) <sup>1</sup>
19	10 (1st winter)	102-122	108-129	355 (males) <sup>1</sup>
20	10 (1st winter)	123-134	130-144	380 (males) <sup>1</sup>
21	10 (1st winter)	135-156	145-174	406 (males) <sup>1</sup>
24	10 (1st winter)	156	174	500+ (males) <sup>1</sup>

<sup>1</sup> Wing data mainly after Trautman (1950) and Etter et al. (1970); tail data from various sources.

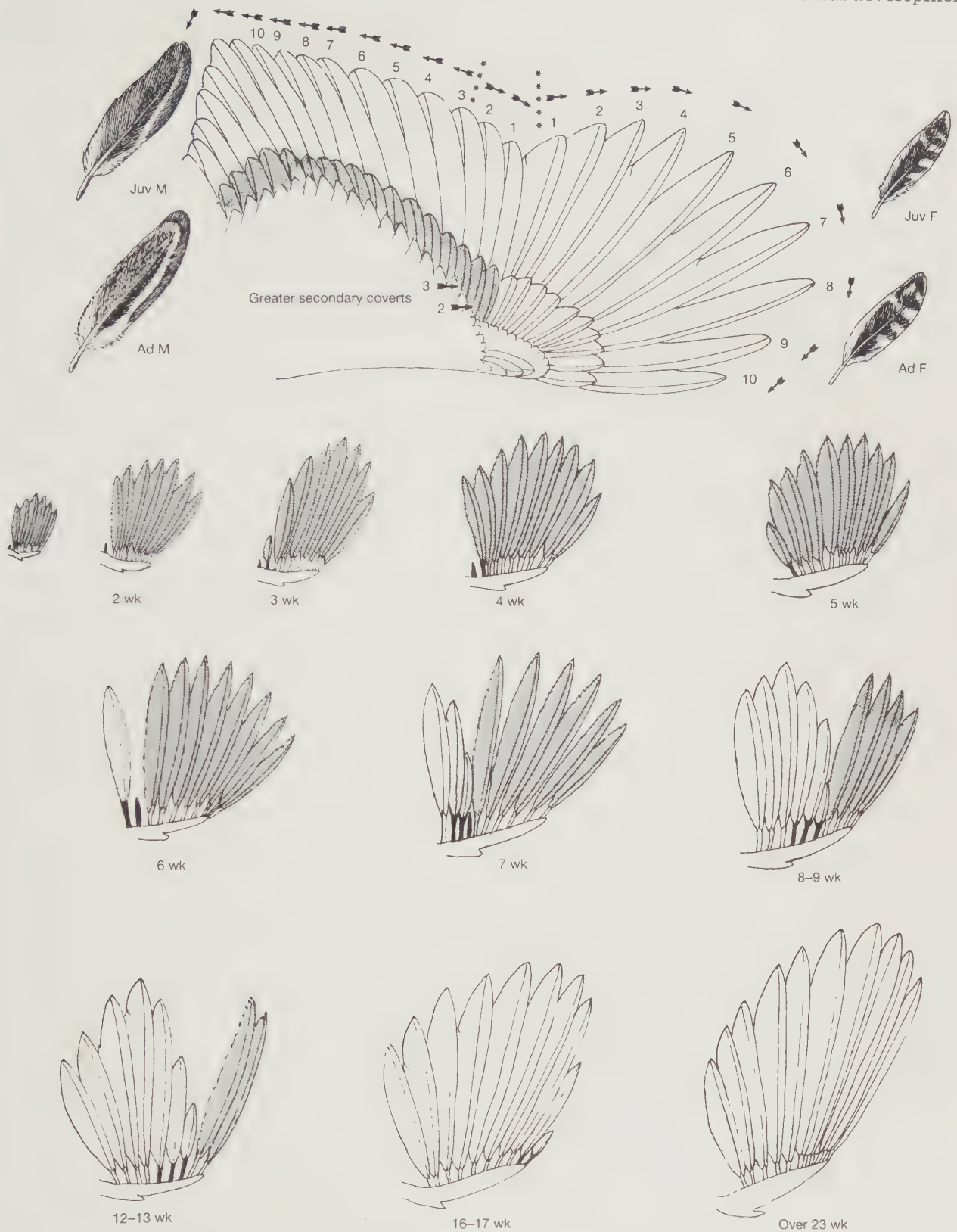
which is usually present from the third day, involves alternating series of backward strokes with each leg. Food-running, which is usually elicited when a chick seizes a large morsel of food, especially living food, is present from the second day after hatching. While running it also utters repeated peeping calls. Its function seems to be that it attracts other members of the social group, thereby increasing the chances that the prey will be killed and made edible. Later, the running behaviour acquires a secondary function of preventing other chicks from stealing the prey. This behaviour is the ontogenetic precursor of 'tidbitting' behaviour, one of the basic sexual displays of pheasants and many other galliform birds. A few other behaviours that are also associated with feeding activity are bill-wiping, bill-beating, head-scratching, and head-shaking movements, all of which appear by no later than the end of the first week.

Comfort activities of newly hatched chicks include stretching and wing-flapping movements. The wings may be stretched bilaterally, during which both wings are partially opened and stretched upwardly and forwardly, or unilaterally, in which a single wing is stretched to the side and rear, often simultaneously with the corresponding leg and foot. Wing-flapping consists of several wing-beating

movements as the bird stands still, often on its toes. Wing-flapping, which occurs by the fourth day after hatching, is the precursor of display wing-flapping, a major sexual signal in many male pheasant species. On the other hand, wing-stretching does not appear to have been ritualized into a display in pheasants.

Preening behaviour takes several forms. Generally it involves pecking, nibbling, stroking or combing of the plumage, all of which occur by the fourth day after hatching. Preening rates vary greatly during growth of the chick, and probably are related to periods of growth and moult of particular feather areas. Related to preening is head-rubbing, head-scratching, and bill-wiping. Head-rubbing may rearrange the head plumage or remove materials from the head, and is present in functional form only after at least 11 days. Head-rubbing with rotation, which is related to obtaining and spreading the secretions of the uropygial gland, is present from about the 11th day, when the gland first becomes functionally active.

Dust-bathing, which gradually develops into its full form, consists of several elements that may be present from the first day or appear after up to about 12 days. These include bill-raking, ground-scratching, wing-shaking (to sweep sand into the plumage), lying on the side, and head-rubbing. Dust-bathing is



**Fig. 9.** Dorsal view of common pheasant wing (above), showing numbering of primaries and secondaries, moult centres (stars), and directions of moult in remiges (arrows), greater secondary coverts (shaded), and patterning of second and third greater secondary coverts in adults and juveniles of both sexes (after Sutter 1971). Also shown (below) are selected stages of primary development in common pheasants during growth, with juvenal primaries indicated by shading and actively growing quills indicated by black bases.



frequently performed throughout life, especially if the proper warm, dry, and loose substrate materials are present.

Various shaking movements, such as the previously mentioned head-shaking behaviour, are commonly performed. They include shaking of the wings and body, the tail, the head and neck, and the legs, all of which often occur in various combinations with one another and with wing-flapping.

The sleeping posture of junglefowl and other galliform birds involves tucking the bill into the scapular feathers. In junglefowl this posture is not fully attained until about the 14th day, when feathers in this region have grown sufficiently to hold the bill in place.

Defecation in junglefowl is often associated with backward stepping and bilateral wing-stretching, and is present from the first day after hatching.

Early escape behaviour includes the alert posture, head-shaking, running, and squatting. In the alert posture the bird stands still, with outstretched neck; in chicks this is often accompanied by calling, especially during the first few days. Head-shaking is also often performed in this posture. Squatting occurs from the first or second day after hatching, and by the end of the second week is replaced by 'freezing' without sitting. A variety of calls are associated with escape behaviour, as will be noted later.

Early aggressive behaviour also includes a variety of components. Unoriented hopping, which develops out of simple hopping, may lead to approach or retreat from other individuals. By the time the chicks are about a week old, the hopping becomes directed toward other individuals, and at about the same time 'frontal threatening' appears. This is a brief neck-stretching toward the other individual, and later this becomes more conspicuous as neck hackles appear and are erected during the behaviour. Somewhat later, between the 9th and 12th day, leaping begins, and shortly thereafter aggressive pecking also appears. By the time the chicks are three weeks old the final component, kicking toward the opponent during leaping, is also beginning, although it is not of general occurrence until the birds are nearly twice that age.

From the age of three weeks, fighting behaviour in young junglefowl begins to exhibit elements of escape, and from then on fighting becomes an ambivalent activity reflecting both attack and escape tendencies. Furthermore, irrelevant actions, such as ground-pecking, head-zigzagging behaviour, and preening all begin to appear and seem to reflect ambivalent motivation. Social peck orders, which start to develop during the first stage of aggressive behaviour become more fully established during the

second stage, and young females (pullets) generally become lower in rank than young males (cockerels). Gradually a relatively linear social hierarchy develops, with the linearity probably resulting from differential rates of development in individual birds (Rushen 1982).

An important social signal that first appears in the context of fighting is 'waltzing'. In its full form the displaying bird walks sideways around its opponent and holds its back and shoulders in an oblique manner, with the side nearest the opponent lower than the other one. Both wings are laterally extended somewhat, but the primaries of the outer wing are lowered to the ground and pulled forward, their plane near the body and the longer primaries scraping the ground. The outer foot typically also makes scratching or stepping movements through the primaries. The tail is spread and turned toward the opponent, and the breast and belly feathers are also often spread. Waltzing may be virtually stationary, with foot movements limited to ground-scratching, or it may involve a circular movement around the other bird. Two displays are often associated with waltzing and contain similar components. The first of these is 'side display', in which the outer wing is kept folded, but the same oblique body posture as occurs in waltzing is assumed. Small, deliberate steps are typically taken during side display. In 'two-sided wing-lowering' a frontal rather than lateral orientation is assumed, and both wings are lowered toward the ground. In this display the ruff is frontally erected, and ground-scratching with both legs may be performed. All three of these displays may occur as early as 50 days after hatching, but are still rare at this time (Fig. 10).

As males become older, they exhibit a combination of sexual and aggressive patterns that become eventually integrated into courtship and copulatory behaviour. Pure sexual behaviour, or copulation, takes a similar form in all pheasants. In the junglefowl the male typically approaches the receptive female from behind, usually with the neck stretched upward but the bill pointed downward toward the female. As the female crouches he mounts, sits on his tarsi which rest on her back, and often either pecks at her nape or grasps her head feathers. The male then begins an alternate trampling movement with his feet, and begins to tilt his body backward. The tail is lifted, spread, and then brought downward to meet the female's cloacal area with rapid sideways movements. After the final cloacal contact the male releases the female and dismounts. No complex postcopulatory behaviour is typical of pheasants.

In junglefowl chicks between 30 and 80 days of age, copulatory behaviour occurs more or less in





**Fig. 10.** Displays of male red junglefowl, including fighting by cockerels (A), lateral wing display by cockerel (B), running with bilateral wing-lowering (C), pre-copulatory approach (D), tidbitting (E), and waltzing (F). After various sources, including Kruijt (1964).

behavioural isolation, without strong aggressive or escape elements. At later ages, these elements are more apparent, and at this stage differences in the behaviour of males and females become important. Evidently the sitting (sexual crouching) position of a receptive female is especially important, since it is the only posture that does not elicit strong, competing agonistic tendencies. Since only females assume the sexual crouching position this provides an automatic means of sexual identification, and reduces the chances of males attempting to copulate with other males or to attack females. However, males

may attempt to force females (or other males) into the crouching position and attempt to copulate with them.

Other than copulatory behaviour, social responses of maturing male junglefowl toward other males or females consist of four more or less functional units, or displays. The first two of these are waltzing and wing-flapping. Waltzing has already been described in some detail, and may be performed toward social partners of either sex. It may be followed by ground-pecking or pecking at the head of the other individual, or may also be followed by a conspicuous turn-

ing away of the body from the partner, so that the other side of the body is exhibited and the other wing lowered.

Wing-flapping, in its social display context, appears between the ages of 80 and 120 days, and often precedes attack. A large variety of wing-flapping types occur, but in its most vigorous form the wings beat together and produce a clapping sound. The male may then fly into a high place and continue to beat the wings after landing. This is often followed by a crowing call. In many species of pheasants this becomes one of the major male advertising signals of sexually active birds. Wing-flapping may also occur when the male is in a submissive position, but in this case the tail is not erected, the wings are not raised high above the back, and the flapping is done in a weak and listless manner.

Tidbitting behaviour, a term first used by Domm (1927) in describing the sexual activity of domestic fowl, is a basic form of sexual display in junglefowl and probably in all pheasant species. It consists of ground-pecking behaviour that is directed toward edible or inedible objects, often with associated ground-scratching behaviour, and is accompanied by high-pitched and rhythmically repeated calling. The ontogenetic precursor of the calling is the food-run call of chicks, and in adult females tidbitting calls are used to attract their chicks to food. Thus, tidbitting serves several roles, including parental bonding between females and chicks, social bonding between the chicks of a brood, and as a sexual bonding between adult males and females.

The last major social signal of male junglefowl is called cornering (Wood-Gush 1954, 1956). In this behaviour a male runs to a corner of its enclosure, stamps its feet, and lowers itself to the ground. The bird may remain silent, or utter a repeated low purring note, especially after the male has settled and stopped moving its legs. Or, the male may utter tidbit calls at this time. This behaviour has a strong attractive effect on females, and perhaps helps the female decide on a particular nest-site location. It is

possible that it also serves as a nest-building mechanism, since males often perform ground-pecking movements at this time, and may hold bits of grass or straw in the bill. Both tidbitting and cornering behaviour appear at about the same time that successful copulations begin, and during all three behaviours similar leg movements occur. However, waltzing behaviour most often occurs between these displays and copulation attempts. Thus, although waltzing is apparently derived from an ambivalence between aggressive and escape tendencies, it is actually more likely to occur in copulatory than in purely aggressive situations and so becomes a 'courtship' display.

Female junglefowl behaviour patterns develop along similar lines as those of the males, but fighting behaviour is typically less prolonged and attempted mating behaviour is extremely rare or perhaps absent, although it has been observed in domestic fowl. Although wing-flapping behaviour is performed, the wing-clapping version is evidently lacking. Likewise, complete cornering behaviour is apparently rare or absent. Sexual crouching behaviour begins in females at four or five months of age, and is most often performed before males in response to waltzing, but may also occur as a response to attack behaviour.

The effects of partial and complete social isolation during ontogeny have been reported by Kruijt (1964, 1966). Males raised in partial visual isolation for varying lengths of time tend to exhibit increased escape behaviour that eventually disappears and is replaced by self-directed attack behaviour toward their own tail as well as aggressive behaviour toward humans. None of three males isolated from hatching until they were 15–16 months old performed copulatory behaviour, and only two of eight that were isolated until 10–14 months old did so. Three males that were raised in total visual isolation (but able to hear one another) totally lacked normal social behavioural responses. Results of limited testing on females gave similar results to those found for males.



## 4 · General and social behaviour

### Sensory abilities

Based on reviews by Fischer (1975) and Wood-Gush (1955), a rapid review of sensory capabilities of domestic fowl seems germane, inasmuch as it is probably relatively applicable to pheasants as a group. Vision in the domestic fowl is relatively acute, owing to the large number of cone cells present in the retina. This results in a great importance of colour in the behaviour of domestic fowl and no doubt most pheasants, and helps account for the high incidence of bright male coloration as a social signalling device. The total range of colour perception is probably very similar to that of humans. Unlearned colour preferences of chicks are in the violet and orange regions of the spectrum, and there is a negative preference for green, which may aid in foraging by making other colours easier to find on a grassy substrate and thus more likely to be eaten. Domestic fowl have a total visual field of about 300°, with an area of binocular vision of about 26°. They apparently have an innate depth perception, and also an ability to perceive visual differences in size, shape, and pattern (Fischer 1975). Domestic fowl evidently respond in the same way as do humans to optical illusions that subjectively differ in size, and shadows provide a very important cue to depth perception, which is a learned ability (Wood-Gush 1955).

Hearing ranges in domestic fowl may be narrower than those typical of higher mammals and studies with chicks suggest an auditory sensitivity centred between 100 and 2800 Hz. Vocalizations also tend to fall within this range of frequencies, further suggesting its behavioural significance. Although the taste abilities of domestic fowl are generally considered to be quite poor, chicks do discriminate among various carbohydrates and are sensitive to salt and bitter-tasting substances. Sensitivity to flavours in water is greater than to flavours in solid foods. The sense of smell is believed to be poorly developed in domestic fowl.

Tactile senses in domestic fowl are not well studied, but are no doubt involved in eating, preening, and brooding behaviour. Apparently tactile stimulation is especially important in developing and maintaining the brooding response (Fischer 1975).

### Intelligence, memory, and imprinting

Domestic fowl have been tested in a variety of ways

for their learning abilities, only a few of which need be mentioned here. A few of these studies suggest a learning ability equal to that of lower mammals, while others do not.

Both adult and young domestic fowl improve to about a 70 per cent accuracy on successive discrimination reversal learning tests, which is not much different from the performance of laboratory rats. Chicks can also learn to alternate turning responses in a temporal maze, and may be capable of latent learning. However, they are inferior to cats in active avoidance conditioning tests, and they are generally very poor at learning detour problems (Fischer 1975). Memory in domestic fowl is seemingly not well developed. Various studies suggest that hens may no longer be able to recognize members of their flock after two weeks in isolation, and that bitter or undesirable foods such as nettles or sour dock may be forgotten in no more than 14 days. One group of five-month-old fowls remembered the feeding place of their former run after a two-week period, but another group forgot the geography of their enclosure after three weeks. Learning abilities evidently improve from hatching up to from two weeks to two months, perhaps depending on the complexity of the problem (Fischer 1975; Wood-Gush 1955).

Imprinting behaviour, specifically filial imprinting and the following response, has been well studied in domestic fowl. Normally the critical period for filial imprinting begins almost immediately after hatching and lasts about three days, although isolated birds may imprint as late as 7–10 days after hatching. Chicks given a brief imprinting experience do not usually exhibit sexual preferences for the imprinting stimulus at maturity (Guiton 1961). However, Lill and Wood-Gush (1965) found that in studies of breeds of chickens (white leghorn, brown leghorn, and two hybrid broiler strains) females of both brown and white leghorns exhibited intrabreed mating preferences, which were apparently based on plumage rather than on courtship display differences. In another experiment, males that had been raised with females of their own breed showed intrabreed preferences, while those raised in mixed breeds exhibited only weak intrabreed preferences, suggesting that imprinting effects may indeed influence adult mating preferences, at least in males (Wood-Gush 1971).



### Peck-orders and social dominance

The social hierarchy patterns of pheasants, traditionally called 'peck orders', are extremely well studied in this group of birds and were indeed discovered in domestic fowl. Peck-orders form the primary basis for social integration and group behaviour patterns in this group of birds, and represent an important behavioural mechanism for group survival and social integration. Domestic fowl form individualized dominance-subordinate relationships soon after their first encounters and, in this species at least, such relationships result in the formation of an essentially linear social hierarchy. Typically a mixed-sex flock has two peck-orders, each one unisexual, since males are more aggressive than females and the latter are normally passive in intersexual domination. The maintenance of such peck-orders obviously requires individualized memories and recognition of other flock members, and with separations of two weeks or more such peck-orders may be disrupted through forgetting. Evidently individual recognition depends on the overall appearance of a bird, rather than learning a single feature or a particular area. However, cues that are positively related to social dominance include the size of the comb, absence of moult, overall size, and relative threat posture. Since in part these factors are related to androgen levels, male hormones must also be considered important determinants of peck-order position. On the other hand, the role of estrogen in peck-order establishment and maintenance is apparently still unclear (Fischer 1975; Wood-Gush 1955; Guhl 1953).

In addition to a very large number of studies of peck-orders in domestic fowl, a few studies have also been performed on captive red junglefowl (Banks 1956) and with free-ranging ring-necked pheasants (Collias and Taber 1951). Banks observed no significant differences between the social organization of red junglefowl females (in a confined environment) and those reported for female domestic fowl. He studied 26 females in four separate flocks. A well developed social hierarchy was present in each flock, which was essentially linear but with minor geometrical complexities of organization. Only one observed case of dominance reversal between two females was found as a result of experimental transferring of birds from one flock to another. This occurred when two females that had been introduced into a new flock reversed their dominance positions relative to one another. Long-time members of a given pen enclosure were typically associated with higher social status following such experimental regroupings.

In a field study of ring-necked pheasants, Collias

and Taber (1951) colour-marked 38 male and 170 female birds, and subsequently analyzed their dominance relationships. Among groups of three, nine, and eight males associated with specific feeding areas, they observed only two instances of deviation from a straight-line hierarchy arrangement, and both of these involved a male becoming territorial and thereby gaining at least temporary advantage over two other males. Among 14 females at a feeding station there were only a few deviations from a straight linear social dominance pattern, and among 85 repeat observations of encounters between the same two females there were no cases of reversed social dominance. All males dominated all the females, but stopped pecking them soon after the breeding season began. The authors were unable to correlate body weight with dominance, although the trend was in a positive direction. At least among females, age may have been an important factor, since three of the seven most dominant females at one feeding station were at least two years old. Data on the males are inadequate for similar comparisons.

### Dominance and sexual behaviour

As may be expected there is a positive relationship between the position of a male in the peck-order and his success in mating (Lill and Wood-Gush 1965). Interestingly, the most dominant male may not perform courtship behaviour as frequently as some of the less dominant birds, nor may he necessarily perform the most attempted matings, but is nevertheless most successful in completed copulations. It is equally true that the most dominant females tend to be less sexually receptive than the most submissive ones, since the submissive crouching response of females facilitates copulation (Fischer 1975). Some studies also indicate that males may vary in their rates of courtship, treading frequency, and ability to solicit crouching from females. There is evidence that these individual variations in sexual behaviour may have a genetic basis, and are to some extent sensitive to artificial selection pressures. Interestingly, in one study a negative correlation was actually found between comb size of males and mating frequency, suggesting that mating differences are not simply due to differences in testosterone levels. Differences in mating activities between the selected lines were apparently instead due to central nervous system factors rather than to endocrine or experiential differences. Other studies on heritability of mating tendencies have indicated a surprising negative correlation between semen volume (and sperm concentration) and mating rates. Evidently males that copulate at a high rate are more prone to

ejaculate lower quantities of sperm. In another study it was concluded that there was in fact no correlation between mating frequency and number of males dominated in the flock, nor in male mating behaviour and various indices of aggressiveness. It is thus possible that the most dominant male is not always the most sexually active one, and that his presence might actually lower overall group fertility by hindering other males from mating (Wood-Gush 1971).

### Heterosexual interactions

The major displays that occur in domestic fowl during heterosexual encounters were mentioned in an earlier chapter, and the major postural displays may be quickly summarized here. Some of these have associated vocalizations, which will be discussed separately. Major male displays of the domestic fowl, junglefowl, and indeed of most species of pheasants, include the following postures:

1. **Waltzing.** In this display one wing (the farther one in the junglefowl and domestic fowl) is lowered and the male advances past or around its partner. Frequently the primaries scrape against the ground, and the outer foot also scratches against the lowered primaries. In domestic fowl a lower intensity version of this display, without wing lowering, occurs and is called 'circling'. It probably corresponds to what has been described as 'side display' in junglefowl.

2. **Wing-flapping.** A highly variable display, in which the wings may be moved silently or flapped noisily, including clapping sounds made by the wings striking one another overhead. In many species the display is called 'wing-whirring'.

3. **Tidbitting.** The male pecks at the ground or scratches at the ground while giving food calls. In some species of pheasants actual items of food may be picked up and dropped, or may be held in the bill as the food call is uttered.

4. **Feather-ruffling.** In the domestic fowl the major feathers affected are the hackles of the neck. However, in many other pheasant species the crest, breast feathers, or body feathers in general may also be variably raised or ruffled. In peacock pheasants the entire dorsal plumage is often raised.

5. **Head-shaking.** In domestic fowl and junglefowl the head is vigorously shaken with circular movements. In other species the intensity or form of head-shaking may vary.

6. **Tail-tilting, tail-spreading, or tail-wagging.** Tail exhibition (or the exhibition of specialized tail-coverts, as in peafowl) are common forms of visual signalling in pheasants, and usually occur in common with waltzing, side display, or frontal display.

7. **Frontal display with bilateral wing-lowering.** Although not well developed in junglefowl, this is a major display in many pheasants, and reaches its peak in peafowl and peacock pheasants. Indeed in peafowl it has completely replaced lateral display posturing.

8. **Wattle, comb, or facial engorgement.** Nearly all pheasants utilize the exhibition of temporarily enlarged areas of facial skin as sexual or aggressive signals; the wattled pheasant represents the culmination of this trend, whilst in others such as blood pheasants it is scarcely noticeable.

9. **Cornering.** This display, initially described for the red junglefowl and domestic fowl, is evidently an important precopulatory display in the genus *Gallus*. At least among red junglefowl it also serves in part as a nesting invitation display, and this may likewise be the case with feral domestic fowl. However, in confined domestic fowl it serves primarily as a preliminary to copulation. Another related display, the 'rear approach', involves a direct male approach towards the female from behind, with his head high and his neck feathers variably ruffled.

10. **Crouching.** This female display, essentially a submissive posture, also serves as a specific invitation for copulation. In all pheasant species it takes a similar form, with the bird resting on her tarsi, her wings partially spread, and her head slightly raised. No specific copulatory or postcopulatory displays appear to be present among pheasants, although the usual postcopulatory feather adjustment and wing-flapping is common, especially among females.

Other species of pheasants possess certain additional displays that seem to be lacking in domestic fowl or, if present, have not yet been recognized as such. Thus, male tragopans evidently perform short display flights to elevated perches, and of course they also have elaborate display postures associated with exhibition of their normally hidden gular lappets and 'horns'. Most and perhaps all male pheasants utter loud advertising calls, sometimes in conjunction with noisy wing-flapping displays or other posturing. Nearly all pheasant species so far studied perform a display similar to or equivalent to waltzing, although it takes great differing forms in different genera. Waltzing may, however, be lacking in peafowl, *Afropavo*, and some of the peacock pheasants, or perhaps it has been so greatly modified in them as to become unrecognizable.

### Egg-laying and incubating behaviour

Nest-site selection and associated egg-laying behaviour has been studied but little in domestic fowl, although some aspects of nest-site selection have



been studied in ring-necked pheasants. Among domestic fowl it has been learned that females typically visit several potential nest sites before selecting one, and that young females appear to be very nervous about choosing a site. If an egg is already present at a site, the site becomes more desirable, although china eggs are less attractive than real eggs, and wooden or plaster of paris eggs are superior even to real eggs. Likewise, concealed sites are more attractive than open sites, and certain materials such as straw, excelsior or wood fibres have been found to be superior to other materials. Evidently the majority of domestic fowls leave their nests before one o'clock, suggesting that even under domestication the usual galliform pattern of early morning egg-laying has been retained (Wood-Gush 1955).

Nest-building behaviour in other pheasants takes a similar form. In pheasants, as in all Galliformes, the females are unable to carry nesting material about, and instead simply gather together what can be obtained by reaching out and tossing materials back toward the body. Nearly all pheasants construct simple nests in shallow scrapes in this manner, but in tragopans, crested argus and great argus the nests are often placed in elevated situations.

Domestic fowls, and probably nearly all pheasants, are indeterminant layers, and continue to lay eggs if they are unable to complete a clutch. Likewise, if the eggs do not hatch, or if artificial eggs are used, the incubating behaviour can be extended well beyond normal limits. The shift from incubating behaviour to brooding behaviour evidently requires both visual and auditory stimuli, and the presence of downy chicks can induce broodiness even if the hen has not previously been incubating. These chicks must still be in the downy stage, and if they are replaced by young birds every few weeks the broody period can also be extended well beyond its normal length (Fischer 1975). Although caponized male domestic fowl can be readily induced to brood chicks, and normal males can be stimulated to brood chicks by means of prolactin treatment, it is apparently not possible to stimulate males to sit on eggs (Wood-Gush 1955).

The egg-laying rate of domestic fowl is an egg per day, while in the common pheasant the average egg-laying interval is about one egg per 1.4 days. In all the pheasants incubation behaviour begins with the last or penultimate egg.

### Parental behaviour

Evidently chicks learn to recognize their mothers by a variety of means. If chicks of different broods are placed together in the dark there is a tendency for the young to find and go to their own hens, suggest-

ing that acoustic clues may be useful in hen-chick recognition. However, visual clues may also be important, for when chicks from hens of three different colours were placed together and in sight of hens with colours like their mothers, those from black hens went to the black female, those from red mothers went to the red hen, and those from white mothers went to the white female. However, some of the chicks did make incorrect choices. Studies on hen-chick interactions suggest that females learn to recognize their own young by a complex 'recognition-impression' process involving the entire brood. Thus a strange chick is likely to be accepted if it has the same general characteristics as the brood, whereas obviously different chicks may be attacked. Evidently, appropriate chick behaviour is more important than chick colouration in this regard. Domestic fowl chicks remain in close physical contact with their mothers for the first 10 to 12 days, and then enter a dispersal period in which they begin to feed independently but still sleep and brood under her. This stage lasts until the chicks are six to eight weeks old, and the brood then gradually dissolves. Broods of pheasant chicks also tend to break up at this time. A few domestic fowl broods may last for as long as 12 to 16 weeks, but eventually the female loses her brooding tendencies and drives the chicks away (Wood-Gush 1971). In peafowls and their relatives brooding takes an interesting form in that the female typically broods a single young under each wing (in most of these species two eggs are the normal clutch), with the chicks facing forwards and their heads sometimes protruding from the front of the wing. Such brooding may occur on large branches of trees, as well as on the ground.

### Chick vocalizations

Three types of calls of chick ring-necked pheasants have been described by Heinz and Gysel (1970) as being peculiar to young up to seven weeks of age. A 'content' call is uttered by chicks when they are warm, resting with other young, or settling down for the night. This is a two-syllable call, with emphasis on the second syllable, *ter-rit*, or *ter-wit*. A 'caution' call is uttered by the chick when it is presented with a strange object. A third call, seemingly a general distress call, is uttered by birds separated from the hen or by isolated, hungry, or cold chicks.

Similarly, in the domestic fowl the chick utters a 'trill' or prolonged 'pleasure' call when it is touched by a human or another chick, and a shrill 'distress' call which is given as part of escape behaviour, and consists of repeated loud peeping notes (Wood-Gush 1971). The distress calls of ring-necked pheasants and domestic fowl chicks are very similar acousti-



cally, judging from published sonograms. A third call, uttered by junglefowl chicks during food-running behaviour, is similar to the distress call in that it consists of rapidly repeated peeping notes.

### Adult calls

Adult calls of the domestic fowl have been reviewed by Wood-Gush (1971), who has attempted to provide synonyms of various names that have been applied to them by earlier workers. Crowing is the best known of all male domestic fowl calls, although occasionally laying hens may also crow. The call may function as a territorial claim and attract females, and the crowing rate of a male seems to be positively related to his position in the peck-order. Crowing in male ring-necked pheasants has also been attributed to territoriality, although Heinz and Gysel found no evidence that it prevents other males from approaching nor did it obviously attract females. Crowing by pheasants is most often performed at dawn and dusk, and especially during spring, but may occasionally be heard all year long. Temperature, humidity, fog, mild rain, dew, and other similar weather factors seem to have no significant effect on crowing rates in pheasants.

Warning or alarm notes take several forms in domestic fowl and pheasants. In domestic fowl the note uttered in response to hawks or other aerial predators is a loud, sustained and raucous scream that stimulates chick to run and hide. Only adult males utter it, according to Collias and Joos (1953). A ground warning call is an initially segmented and then sustained call that may last more than a second. A third type of warning call is a 'fear squawk', which resembles the aerial predator alarm note in that it is sustained and has a mottled acoustic pattern. It is uttered by a female that is being held. In ring-necked pheasants, males utter a loud alarm call that somewhat resembles the crowing call, but is of varying numbers of syllables and is less well defined harmonically. Females utter a 'brood caution' call similar to the ground-predatory warning call of domestic fowl, and also have a distress call that is rather high-pitched, descending in frequency, and similar to the fear squawks of domestic fowls in both structure and function.

Threat calls of male domestic fowls are fairly continuous, with an emphasis on lower frequencies; they are sometimes rather pulse-like. Likewise, male pheasants utter a similar 'antagonistic' call that is a hoarse *kraah* and may be quite prolonged and pulsed. It is apparently often used by dominant males toward submissive ones (Heinz and Gysel 1970).

An 'alert' call is used by domestic fowl in response

to the presence of a passing animal or a strange sound, and resembles the ground predator call but has a more variable frequency pattern.

In pheasants, males often utter a 'flight' call as they take wing to flee, and females sometimes do the same, especially those with broods. After taking flight, a female with a brood may land and begin to utter a 'brood-gathering' call as she gradually returns to the point from which she took flight. This clucking or barking call evidently helps to reassemble the scattered brood.

Both sexes of pheasants utter hissing calls when they are intimidated, and 'pecked' calls when they have been pecked. Female pheasants have also been heard to utter a high-pitched squeaking call when fleeing or when otherwise distressed by potential danger, and females also utter a special precopulatory call when crouching or at times also during copulation (Heinz and Gysel 1970).

Special calls of the domestic fowl that are limited to the females include a *ku* call that is associated with feeding or mating, an aggressive call somewhat similar acoustically to part of the aggressive call of males, and a call that is given before egg-laying and in some other situations. This same call may very occasionally be uttered by a defeated male. Broody hens utter a considerable number of special calls. These include nest-defence calls, calls uttered before egg-laying, those associated with agonistic encounters while sitting on the nest, and the like (Wood-Gush 1971). Inter-individual variations in calls might perhaps be especially associated with the crowing call, given its probable role in male advertisement and possible mate recognition. However, Heinz and Gysel reported more variation in male alarm calls than in crowing calls, and a good deal of variation in chick calls as well. Nevertheless, female pheasants are evidently able to recognize their own mate's crowing call (Kozłowa 1947), and it has recently been found that the male crowing calls of red junglefowl also exhibit individually distinctive acoustic characteristics.

Thus, Miller (1978) reported considerable intra-individual consistency and inter-individual variability in several aspects of red junglefowl crowing characteristics, including frequency modulation, number of discrete notes per call, call duration, duration of first and terminal notes, and dominant frequencies. He noted only minor differences in crowing characteristics between red junglefowl and domestic fowl, supporting the general notion of monophyletic origin of domestic fowl from the red junglefowl.

In all, Heinz and Gysel (1970) described a total of some 15 different calls of ring-necked pheasants, including three characteristic of chicks, six limited

to females, three limited to adult males, and two (hiss and 'pecked') characteristic of adults of both sexes. Including a considerable number of calls that are limited to laying or broody females, a total of 19 adult call types have been described for domestic fowl (Wood-Gush 1971). Obviously, the classification and numbering of calls is greatly complicated by variations in their intensity and other difficulties of acoustical analysis, and it is questionable whether such comparisons are useful at this stage. However, it is evident that some general coding characteristics of domestic fowl calls do exist. Thus, sounds that attract young chicks tend to be brief, repetitive, and contain an abundance of relatively low frequency notes. On the other hand, sounds that signal warnings to chicks tend to be of relatively long duration, have relatively little repetition or segmentation and are weak or lacking in low frequencies (Collias and Joos 1953). Similarly, in adult calls there may be both attracting or alerting qualities having similar acoustic characteristics, and grading of acoustic signals can be attained by varying their duration, pulse rate, call loudness and the duration of intervals between calls.

### **Feeding behaviour**

Although it is obvious that pheasants vary individually, geographically, and taxonomically as to foods and foraging adaptations, it is difficult to generalize much on this activity. All pheasants are largely vegetarian, and the majority are adapted to seed-eating, although some species such as the koklass con-

sume a surprisingly high proportion of green material, while others such as the monals obviously do a great deal of digging for subterranean vegetable matter. Studies of domestic fowl suggest that individual birds often have definite preferences for particular types of food. Evidently such individuals form preferences for foods on the basis of form and colour, perhaps with the aid of tactile impressions, but with taste differences evidently of little significance. Foods with shiny or glittering surfaces may be preferred over less conspicuous types, and there seems to be an innate preference for grains having elongated rather than rounded forms. Other studies have suggested that larger (unbroken) grains are preferred over smaller grain fragments, and that the birds are also able to select foods that result in good diets over those that are inadequate in some dietary respect (Wood-Gush 1955).

It is probably true that in all the Phasianidae there is a high incidence of live animal foods, especially insects, consumed during the first few weeks of life, and this ratio of animal to plant foods rather quickly declines during ontogeny. By the time the birds are adults, probably over 90 per cent of food intake normally comes from plant sources, to judge from information on a variety of pheasant and partridge species. A more detailed survey of foods and foraging adaptations of pheasants will be found in the following chapter dealing with ecology, but it is apparent that feeding behaviour in young chicks is largely related to the detection and capture of living prey, while in adults it is probably more dependent upon the recognition of inanimate food sources.



## 5 · Ecology and population biology

### Ecological habitat distributions and population densities

Relatively few detailed ecological studies have been carried out on wild pheasant species within their native ranges, and fewer still have attempted to deal with all of the pheasant species of a given region. Perhaps the best of these, and one that will provide a useful insight into such environmental controls as elevation, vegetational relationships, slope effects, and other local ecological factors is that done by Gaston, Hunter and Garson (1981) in the western Himalayas of Himachal Pradesh, India. In this area of extreme north-west India a large number of river systems flow westward out of the Himalayas, all eventually reaching the Indus. There is also a substantial accumulation of snow, reaching as low as 1600–1900 m during mid-winter. The mountain flora is primarily derived from the Sino-Japanese floral region, and the temperate fauna is also mainly eastern rather than western in its relationships.

The major montane vegetational types are zonally organized, and may be briefly mentioned. The lowest of the montane forests is the subtropical pine forests, from 600–1700 m, and dominated by Chir pine (*Pinus roxburghii*). There is also a subtropical dry evergreen forest from 500–1000 m, dominated by a mixture of several genera of tropical trees. The most important pheasant habitat zone is the Himalayan moist temperate forest, between 1500 and 3000 m, and dominated by such temperate trees as oaks (*Quercus*), firs (*Abies*), pines (*Pinus*), horse chestnut (*Aesculus*) and deodar cedar (*Cedrus deodara*). There is also a dry phase of Himalayan temperate forest, dominated by Holm oak (*Q. ilex*) and edible pine (*P. gerardiana*), occurring at approximately the same altitudinal zone. Above these is the subalpine forest zone, from 3000–3400 m, which is dominated by birches (*Betula*), firs (*Abies*), and pines (*Pinus*). There is also a subalpine scrub community of *Rhododendron campanulatum* at about 3400–3500 m, finally grading to a dry alpine scrub of lower rhododendrons and junipers reaching up to approximately 3800 m.

Seven species of pheasants occur within this general area (Table 8), all of which are partially to totally herbivorous and variably important in ecosystem composition. The red junglefowl is largely limited to the subtropical zone below 1200 m, where it is most abundant in dry evergreen forest,

especially where dense undergrowth also occurs. The Indian peafowl occurs widely on agricultural lands when it is locally protected. Otherwise it is limited to similar habitats to those of red junglefowl, but extends locally into lower oak forests. The kalij pheasant occurs locally between about 1200 and 2500 m in forested areas along the front ranges of the Himalayas, often being most abundant in disturbed forests fairly close to human habitations. It is often common both in lower oak and lower conifer forests, with some apparent preference for the former. The cheer pheasant is typically associated with steep, grass-covered hillsides having scattered trees, especially where rocky crags are also present. The presence of dense grasses appears to be an important habitat attribute. In some protected areas its density may be as high as six pairs per km<sup>2</sup>. The koklass occurs over a similar altitudinal range, but is associated with a variety of forests having well developed understories, and is especially associated with oak forests. It locally reaches densities of as much as 17–25 pairs/km<sup>2</sup>. The fourth species associated with middle-altitude grasslands and temperate forests is the western tragopan, an endangered form now limited to relict areas of temperate and subalpine forests, and especially higher altitude conifer forests. The last of the Himalayan pheasants of this area is the Himalayan monal, which occupies subalpine oak forests and reaches as high as subalpine meadows and scrub vegetation. This same zone is sometimes also used by the cheer pheasant, perhaps because of the subalpine zone's vegetational characteristics. The koklass, however, rarely reaches the subalpine zone. The major habitat difference between the monal and the koklass appears to be in the extent of ground and shrub cover needed, with most of the koklass records attained in areas having more than 70 per cent ground cover, while less than 30 per cent of the monal records occurred in such cover. Both of these species exhibit a strong seasonal shift to lower habitats between December and March, with a return upward movement in April and May. In this area slope and exposure, in so far as they affect snow cover, are important to pheasants, since they not only influence food availability but also relative access by people and livestock. Thus steep forest slopes usually support denser vegetation and perhaps also facilitate escape by downhill running. Thus monals, for example, tend to occur on



**Table 8.** Comparative altitudinal distribution of Himalayan Phasianidae

Western Himalayas <sup>1</sup>		Elevation (metres)	Eastern Himalayas <sup>2</sup>	
Typical species (altitudinal range)	Vegetation zone		Vegetation zone	Typical species (altitudinal range)
		4500	Alpine zone	Snow partridge
		4000	Subalpine scrub ( <i>Rhododendron</i> )	Chinese monal Tibetan snowcock (4500–5000) Verreaux' monal partridge (4000–4500) White eared pheasant (3200–4200)
	Dry alpine scrub ( <i>Juniperus</i> )	3500	Holly oak; Conifer forest	Blood pheasant (3200–4200) Koklass (3000–3200)
Himalayan monal (2500–3300)	Moist alpine scrub ( <i>Rhododendron</i> ) Subalpine Forest	3000		
Western tragopan (2500–2800)	Himalayan temperate forest (moist and dry)	2500	Agricultural lands	Common pheasant (under 3000) Lady Amherst's pheasant (under 3000)
Koklass (1800–3300)				
Cheer (1500–3100)				
Kalij (1200–2500)		2000		
Indian peafowl (500–1900)		1500		
Red Junglefowl (700–1400)	Subtropical forest Subtropical dry forest	1000		

<sup>1</sup> Data from Himachal Pradesh, India (adapted from Gaston, Hunter and Garson, 1981).<sup>2</sup> Data from Western Szechwan, China (after Schäfer 1948).

valley slopes rather than in valley bottoms (Gaston *et al.*, 1981).

By comparison, Schäfer's (1938) description of the distribution of pheasants in western China indicates a similar vertical segregation of pheasant (and partridge) species and associated habitats, in this case involving six species of pheasants and three of partridges. Only a single species was reported for both areas, the koklass, and in China that species was found in similar habitats but at approximately a thousand metres higher. Similarly, the Chinese monal occurs at a substantially higher (approximately 2000 m) altitude in China than does the Himalayan monal in India. Interestingly, the major difference between these two species is a substantially larger body size in the Chinese form, which perhaps is an ecological adaptation for survival at these appreciably higher elevations and presumably colder temperatures.

Doubtless similar patterns of altitudinal zonation of pheasants occur throughout Asia, including tropical areas. One of the few that allows for a vegetational and altitudinal habitat analysis is that of

Davison and Scriven (1984), who described the vegetational zonation and pheasant distributions typical of peninsular Malaysia. In that area eight species of pheasants and two additional partridges occur, and their altitudinal and vegetational habitat relationships are summarized in Table 9. Two of the eight pheasants, the red junglefowl and the green peafowl, have generally broad distributions in south-east Asia, but the green peafowl has apparently been extirpated from peninsular Malaysia. The climax forest vegetation of this area consists of tropical evergreen and semi-evergreen rain forests. The Malayan evergreen forest is characterized by an abundance of both types of shorea (*Anthoshorea* and *Rubroshorea*), high tree species diversity, and a tall forest profile with a multi-layered vegetational canopy. The lowland forests consist of lowland and hill dipterocarp (Dipterocarpaceae) subtypes, the lower montane forest of upper dipterocarp and oak-laurel subtypes, and the upper montane forest of a montane ericaceous community. Three of the six species of forest-adapted pheasants are found in the lowland dipterocarp community type, including the

crested fireback, the crestless fireback, and the Malayan peacock pheasant. The Malayan peacock pheasant is found on level or gently sloping ground in both logged and unlogged forests. The crested fireback is found only near moderate to large rivers in lowland dipterocarp forests developed over level alluvial riverine terraces. Thus it has a much more restricted distribution than the peacock pheasant or the crestless fireback. The latter occurs on level, gently sloping, and steeply sloping habitats within the dipterocarp forest community. It has also been observed in both logged and unlogged sites, while the crested fireback has not been observed at the latter type of habitat. The great argus pheasant is found in most lowland and hill dipterocarp forest sites, but is absent from heavily disturbed and fragmented sites. It reaches the boundary of the lower montane (upper dipterocarp) community only in one site where the crested argus is lacking, suggesting that ecological exclusion is occurring. The crested argus has a much more restricted geographic distribution than does the great argus, and also exhibits a curious habitat restriction to the hill dipterocarp and lower montane transitional forest, perhaps in both cases as a reflection of competition with the great argus. The Rothschild's peacock pheasant has been observed only in locations above 900 m, typically on steep slopes with exposed rocks and some bamboo and climbing stemless palms. The birds seem to be limited to ridge crests, where they appear to be fairly common, although no density estimates have been made.

### Home ranges and movements

A considerable number of studies have been performed on the ring-necked pheasant as to its home

range, all of which have indicated a remarkably small daily and seasonal mobility pattern (Olsen 1977). Probably individual daily movements average no more than half a mile and during winter the daily movements between food sources and cover are usually less than a quarter of a mile (Schick 1952). Of twelve groups of wintering pheasants studied in Wisconsin by Gates and Hale (1974), only one group travelled as far as a half mile between food and cover, and the other 11 moved a quarter of a mile or less. These and other observations led the authors to believe that wintering birds rarely travel more than a quarter of a mile from day to day, and probably never more than half a mile. Indeed, the average distance of movement of all birds observed between 1 January and the winter breakup of flocks averaged only 0.4 mile (405 observations), which closely compares to earlier studies on the species. The onset of spring dispersal differed considerably with sex and age, with males tending to move away from wintering areas and establish breeding territories in late March or early April, while females remained on wintering areas until mid-April. Young females typically departed from wintering areas after the adults, while young males did not exhibit obvious differences from adult males. However, young males tended to disperse farther from winter cover than did adults (averaging 0.67 miles vs 0.24 miles), and one of 77 dispersed as far as 3.4 miles, while no adult male moved farther than 1.8 miles. Likewise, young females dispersed farther than adults (averaging 1.31 miles vs 0.75 miles), and 6 of 428 moved 4 miles or more from their winter cover, while the maximum movement of adult females was one movement of 4.9 miles from winter cover. Generally females were more prone to return to earlier nesting areas than to areas used the previous winter. Likewise, adult

**Table 9.** Comparative altitudinal distribution of pheasants in peninsular Malaysia<sup>1</sup>

Vegetation type	Elevation (metres)	Pheasant species	Estimated Density/Km <sup>2</sup>
Scrub and disturbed habitats	Variable	Red junglefowl Green peafowl	Common Extirpated
Forest habitats			
Lowland dipterocarp	0–200	Crested fireback (to 200 m) Crestless fireback (to 200m) Malayan peacock pheasant (to 200m)	2.67–10.67 (both sexes) 0.6–6.0 (both sexes) 10.5–2.5 (males)
Hill dipterocarp	200–1000	Great argus (to 1000m)	0.31–4.5 (males)
Upper dipterocarp	1000–1200	Crested argus (790–1080m)	1.9–3.0 (males)
Oak–Laurel	1200–1500	Rothschild's peacock pheasant (900–1800m)	Common (?)
Montane ericaceous	over 1500	—	—

<sup>1</sup> After data presented by Davison and Scriven (in press).



males remained faithful through their adult lives to the areas in which they first bred. Thus, the location of the breeding area exerted a major influence on male movements after their first spring of life, with the birds either occupying the same home range in winter or moving the minimum distance to suitable winter cover.

Spring activities in male ring-necked pheasants were found by Gates and Hale to centre on very localized areas that typically were no more than about a half a square mile in size. More than 90 per cent of their May–September observations of males were within a quarter mile of a central (40-acre) unit. Such areas have sometimes been called crowing territories or breeding territories but few have attempted to measure the degree of territorial defence or exclusion of males. Gates and Hale found that spring home ranges tended to be overlapping, and daily movements of males were not confined to a particular area. No part of the home range actually seemed to qualify as a defined territory ('a defended area'), although the males' crowing areas most nearly approached this definition. In such areas the male did his most intense crowing, the harems were gathered within, and courtship and display were most prevalent. However, crowing areas seldom had a common boundary along which aggressive encounters between males occurred, and some males occasionally crowed when as far as a half mile from their regular activity centre. In general, there seemed to be a moving zone of intolerance or individual distance limitations between individuals, rather than geographically definable territories. However, in this study the overall male densities were fairly low (0.7 males per 100 acres), compared with earlier studies such as those of Taber (1949) and Burger (1966) in which more typical territoriality evidently occurred and higher (5.0–5.8 males per 100 acres) densities were present. Thus, Burger reported finding well-defined territories ranging in size from 1.2–9.8 acres, and Taber concluded that territories in April were 12–13 acres, although by mid-June they had compressed to about 6 acres. Stokes (1954) reported similar male territories of 6–10 acres on Pelee Island. Although both Taber and Burger reported the presence of non-crowing and non-territorial birds in the population, Gates and Hale did not observe any such males.

Spring and summer movements by females were similar to those of males, at least during the period May–August. Females showed no clear relationship between the location of their pre-nesting activities and their nest sites, and in fact the birds seemed to show some tendencies to spread out from the areas of harem activities toward more secluded sites. Females that had to nest twice as a result of nest fail-

ure remained in the same general area for their second nesting, with 11 such females moving an average of only 0.23 mile between successive nestings. Likewise the average distances between successive recorded brood movements was only 0.27 mile, and generally the broods were raised within the home range occupied by the female during nesting and pre-nesting periods.

Somewhat comparable kinds of information are available for the red junglefowl, based on studies of free-ranging birds in the San Diego Zoo. Collias, Hunsaker, and Minning (1966) reported that during their study there were in the zoo some 10 major roosts, each having from six to 30 birds, as well as 18 additional minor groups. These birds were highly fixed as to their home canyon, with only about one per cent ever ranging out of the canyons in which they were hatched. Typically each flock might range out some 180–240 ft from its roosting site up canyon slopes or into branch ravines, but only short distances of 100–150 ft down the main canyon, which was in the direction of neighbouring flock territories. Banded individuals moved an average distance of only 248 ft over a three-year period, with females not exhibiting obviously greater movements than males, nor young birds substantially greater movements than adults. Within the flock's home range individual males were organized in dominance hierarchies, and dominant males tended to move outside the flock's overall range more than did subordinate ones. Females also exhibited a considerable degree of site specificity and reluctance to move much beyond their own flock's normal home range. Dominant males typically associated with one to several females, while subordinate males were often excluded from contact with the females. The diameter of the defended area where the birds were most often concentrated typically averaged only 100–150 ft. A few birds that were experimentally moved 1000–1400 ft exhibited no indication of any homing abilities. This high level of locality fixation and territorial attachment is perhaps a hindrance to the species' capacity for range expansion, and it is unknown whether significant seasonal movements occur among red junglefowl in their native habitats. Collias and Saichuae (1967) observed that in Thailand separate roosting flocks were usually situated from one quarter to one half a kilometre apart, but some limited evidence there suggests that seasonal movements of at least several kilometres might occur in southern Thailand. However, in central western Thailand even greater seasonal movements of several miles might occur (Johnson 1963). Studies in north-central India indicate very restricted daily movements of some flocks, which often restricted their activities to an area only



about 150 yd in diameter, although a few birds were observed to move as much as 300 yd in a relatively short time (Collias and Collias 1967).

### Competition and predators

Little can be said of competitive interactions between species of pheasants in the wild. The earlier discussion of habitat affinities in areas of high species density would indicate that even where six or more species of pheasant occur in geographic sympatry there is a high degree of habitat specificity and probably relatively few direct interspecific interactions. However, in some cases such as where the great argus and crested argus occur sympatrically in Malaysia there may indeed be some local interactions and competitive exclusion.

Similarly, the role of predation is extremely difficult to determine in influencing bird distribution and abundance. In spite of hundreds of field studies on ring-necked pheasants in North America, little can be said with certainty about the role of predation on pheasant populations. One of the best such studies was that of Wagner, Besadny, and Kabat (1965), using females that had been equipped with radio transmitters. Among 105 deaths of such birds, 80.8 per cent of the total were attributed to predation. Of these 76 deaths, 46 were believed to be the result of mammalian predation, 19 caused by birds, 11 were of undetermined cause. By comparison, Schick (1952) attributed 36 per cent of 214 pheasant kills found during a two-year period in Michigan to mammals, and 38 per cent to raptors. Gates (1971)

attributed 49 per cent of 194 cases of winter pheasant predation in Wisconsin to avian predators, and only 34 per cent to mammalian predators. Both Schick and Gates believed foxes to be responsible for the majority of mammalian predation cases, while smaller numbers were considered to result from cats, dogs, minks, and weasels. Generally, losses to foxes are believed to be heaviest during winter, although foxes also take some juveniles and adults in summer as well. Among avian predators, Wagner *et al.* (1965) implicated the great horned owl (*Bubo virginianus*) as a significant source of mortality, while Gates (1971) found that in his area the red-tailed hawk (*Buteo jamaicensis*) was responsible for the largest percentage of avian losses. Schick (1952) believed that in his study area the Cooper's hawk (*Accipiter cooperi*) and northern harrier (*Circus cyaneus*) were the most significant sources of predation. Based on information presented by Wagner *et al.* (1965), Table 10 provides some estimates of major known predators of ring-necked pheasants in North America and their possible population effects. Nest predators are not included in this summary. Wagner *et al.* concluded that predation was the most important direct cause of adult pheasant mortality in their study, and that it was likely to be a limiting factor for pheasant abundance in their area.

### Mortality and survival rates

Only a few observations have been made on the mortality and survival rates of pheasants other than the ring-necked pheasant. In their study of free-rang-

**Table 10.** Some estimates of major pheasant predators and their effects<sup>1</sup>

	Results of stomach, pellet or scat analysis			Population estimates	
	Percentage of samples having pheasant remains present	Percentage of studies listing pheasant remains as present		Estimated predator densities (number per square mile)	Estimated annual mortality loss from predators
	Range	Average <sup>2</sup>			
Mammals					
Red fox	0-65	8.9	72.7 (22 studies)	0-4.9 <sup>3</sup>	8-14%
Grey fox	0-13	4.0	62.5 (8 studies)	—	—
Raptors					
Cooper's hawk	0-1	18.1	85.7 (7 studies)	—	1.12%
Great horned owl	0-41	10.5	81.8 (11 studies)	0.2-2.8	—
Red-tailed hawk	0-31	5.3	57.1 (7 studies)	1.0-3.0	—
Northern harrier	—	—	—	—	1-10%
All raptors	—	—	—	—	9%

<sup>1</sup> Data derived from various studies cited by Wagner *et al.* (1965)

<sup>2</sup> Unadjusted for sample size differences.

<sup>3</sup> Includes both species of fox.

ing red junglefowl in the San Diego Zoo, Collias *et al.* (1966) observed a surprisingly high mortality rate. They observed that, of 42 birds banded as adults, 32 survived no more than 12 months, and only 10 (28.6 per cent) survived at least a year, indicating a 71.4 per cent annual mortality rate. Of 46 birds banded when three to five months of age, only 5 (10.8 per cent) survived at least a year. Generally, of every 100 chicks that hatched, only 25 per cent survived to the time of brood breakup, and only about 6 per cent survived to the end of their first year of life. Only three banded individuals were known to have survived more than three years after banding, and these birds must have lived at least four years, since they were all banded as adults. Foxes, feral cats and Cooper's hawks were all considered as possible causes of junglefowl mortality in that area.

A substantial amount of information is available on mortality rates in wild ring-necked pheasant populations, a sample of which might be summarized here. Using a variety of methods of calculating mortality rates, Gates and Hale (1974) reported that adult survival rates among wild female ring-necked pheasants ranged between 11 and 33 per cent, with fall-to-spring survival between 27 and 64 per cent, and spring-to-fall survival between 34 and 58 per cent. Annual estimated survival for adult females was 24 per cent. Male survival varied from 3 to 14 per cent annually, and averaged only 7 per cent. There was little evidence of age-specific survival change, and thus life expectancies did not change after the first autumn of life. These mortality rates are higher than were estimated in various earlier Wisconsin studies (Buss 1946; McCabe 1949), and also tend to be somewhat higher than rates reported from other states.

Probably one of the best studies of ring-necked pheasant mortality is that of Dumke and Pils (1973), which is based on radio-tagged birds. Too few males were tagged to provide useful mortality data, but 137 mortality records for females were obtained. These data for females are summarized in Table 11, which indicate an annual mortality rate of 73.9 per cent (annual survival rate of 26.1 per cent), or extremely close to the figures cited earlier by Gates and Hale. This study indicated that female mortality rates are higher in the spring-to-fall period than between fall and spring, and that they are highest during the hunting season (females being illegal game) and during the winter periods. Lowest seasonal mortality rates occur during the nesting, brood-rearing, and post brood-rearing periods. However, during that same period, losses of brood members are relatively high. Baxter and Wolfe (1973) summarized data on brood losses during the first six to ten weeks after

hatching, and noted that chick mortality rates for eight different study areas ranged from 30 to 56 per cent (unweighted average 38.2 per cent), even though none of these studies was able to pinpoint the primary causes of such high chick mortality. Some studies have implicated high mortality rates with late hatching dates, but others such as that of Baxter and Wolfe have suggested that late-hatched broods actually suffer somewhat lower mortality rates, perhaps because of the more favourable late summer weather and better brooding conditions at this time than earlier in the nesting season.

Wagner *et al.* (1965) extensively reviewed a variety of factors that might influence ring-necked pheasant reproductive behaviour and reproductive success, including weather and climatic effects, farming practices, predation, effects of legal and

**Table 11.** Estimated annual and seasonal mortality rates in female ring-necked pheasants<sup>1</sup>

Mean annual mortality rates	Mortality rate (%)
Overall female population	73.9
Radio-equipped females (N=201)	79.7
Adult females (N=43)	67.3
Juvenile females (N=132)	82.4
<i>Semi-annual mortality rates</i>	
Fall to spring (October 1–March 31)	
Total female population	35.3
Radio-equipped females only	57.8
Spring to fall (April 1–September 30)	
Total female population	57.5
Radio equipped females only	44.8
<i>Seasonal mortality rates (of radio-equipped females)</i>	
Hunting season (October 16–December 14)	
Juvenile females	34.6
Adult females	20.5
Early winter season (December 15–February 18)	
Juvenile females	36.0
Adult females	31.5
Late winter season (February 19–April 14)	
Juvenile females	9.6
Adult females	28.2
Nesting season (April 15–June 28)	
Juvenile females (yearlings)	14.9
Adult females (over one year)	14.5
Brood-rearing season (June 29–August 27)	
Juvenile females (yearlings)	4.7
Adult females	5.2
Post brood-rearing season (August 28–October 15)	
Juvenile females (yearlings)	0.2
Adult females	0.0

<sup>1</sup> Adapted from Dumke and Pils (1973).



illegal hunting of females as well as males, and population density effects. They concluded that at least in Wisconsin populations are generally in balance with the local temperature norm, and that yearly springtime positive deviations from that norm tend to be accompanied by population increases. Prenesting temperatures are probably the most important single weather factor, but may not be the only control. In some parts of the range the severity of the winter may also play an important controlling role. Among farming practices, it was concluded that losses of both nests and nesting females from hayfield mowing are often important, and locally may cause losses of at least a fifth of the nests and nesting females. In areas where haying is important, access to available wetlands for nesting is especially important, since such areas tend to attract enough females to reduce significantly female mortality and increase nesting success. Information on predation effects was inconclusive, but it was suggested that at least in marginal range predators might influence pheasant populations significantly. Likewise, legal hunting of females was considered to exert an important effect on female losses in the population, and even those female losses resulting from illegal hunting might have some depressing effects. Normal hunting harvests of males were not believed to be significant in population control. The major miscellaneous mortality factor was apparently mortality caused by traffic accidents, which perhaps represented a loss of 3–4 per cent of the total fall population. Much of this loss occurs in spring, and thus its effects are magnified by the loss of potentially breeding birds.

The effects of population density of females in influencing reproductive rates was reviewed at length by Wagner *et al.* (1965), who found evidence that in Wisconsin as well as in several other states the reproductive potential decreases as population densities increase. They considered that this might result from competition for space, which was the only definite environmental population control mechanism having density-dependency characteristics that they were able to identify. They concluded that density-dependent effects operate at all population levels, rather than only above certain threshold levels, but that they only influence actual population density in combination with other limiting factors such as weather. Thus, weather may well be the most important overall annual determinant of population productivity in Wisconsin pheasant populations, but the local productivity tends to oscillate around a means that is dependent upon local density, and thus results in compensatory population adjustment. In their view, mean densities in different areas are probably the result of variations in den-

sity-independent mortality factors, while temporal variations in a given area are the result of a combination of density-dependent and density-independent effects.

### Foods and foraging ecology

Foraging by all pheasants is done primarily on the ground, and their stout toes, strong claws, and sharp bills are well adapted for digging and scratching. There is some variation in bill shape among the pheasants, and the monals for example have unusually well developed bills for digging out foods from below the ground surface. Roots, bulbs, tubers, subsoil insects, and other invertebrates all are likely to be excavated and consumed by this manner. A few pheasant species, such as the blood pheasants, have relatively weak bills and probably primarily consume greens and fruits, although the koklass has a considerably heavier bill but also evidently requires a high proportion of green materials. The tragopans similarly seem to be relatively dependent upon fruits and berries, but the peacock pheasants appear to have a diet that is relatively high in insects.

Although a limited amount of information is available on the diets of junglefowl based on analysis of crops and gizzards, only the common pheasant has been extensively analyzed as to variations in diet associated with age, season, and geographic locality. Cramp and Simmons (1980) and Glutz (1973) have recently summarized the information on foods of pheasants in Europe, and their reports make it clear that cultivated grains (wheat, oats, barley, maize), seeds, nuts, and fruits are all favoured year-long foods, whilst greens are often taken in spring and arthropods are especially important during summer months. During summer in Europe, up to half or even more of the diet may be composed of animal materials, but plant materials clearly dominate only during the winter months. Various studies in North America suggest that there cultivated grains, especially corn (maize) and secondarily wheat, oats, and barley, play a much higher role in the dietary economy of pheasants than in Europe, and animal materials seem to be consumed in appreciably lower amounts. Olsen (1977) has summarized a large number of food-intake studies of ring-necked pheasants in North America, and reported that there animal materials make up relatively small percentages of the annual diet, including an estimated 1.5 per cent in Missouri (Korschgen 1964), 3.2 per cent in Michigan (Dalke 1937), 3.9 per cent in Minnesota (Fried 1940), 5 per cent in South Dakota (Trautman 1952), and 14.5 per cent in Utah (Cottam 1929). In most of these studies grasshoppers (Locustidae) were



found to be the most important single source of animal foods. Two studies on the seasonal foods of ring-necked pheasants in North America are summarized in Table 12. Studies in all areas indicate that foods of chicks and juveniles are much higher in animal materials, particularly during the first few weeks of

life. During the first week or so insects may represent as much as 80 or 90 per cent of the chicks' food, but between four and six weeks after hatching their diet shifts strongly toward vegetable matter, with grain often becoming a major food item (Table 13).

**Table 12.** Major seasonal foods (percentage composition) of ring-necked pheasants in Missouri and South Dakota<sup>2</sup>

	Missouri <sup>1</sup>					South Dakota <sup>2</sup>					
	Season	Autumn	Winter	Spring	Summer	Yearly average	Autumn	Winter	Spring	Summer	Yearly average
	Sample	114	74	85	45	319	206	213	288	167	874
Farm crops											
Corn ( <i>Zea</i> )	66.9	72.1	65.0	29.5	64.8	67.3	67.2	37.3	25.8	57.2	
Wheat ( <i>Triticum</i> )	1.4	—	tr.	19.0	2.0	4.2	6.9	16.4	27.9	10.7	
Soybeans ( <i>Glycine</i> )	10.8	1.5	—	—	—	—	—	—	—	—	
Sorghum ( <i>Sorjum</i> )	4.0	.6	tr.	tr.	1.6	0.6	1.5	0.7	0.3	0.7	
Rice ( <i>Oryza</i> )	—	tr.	0.1	14.7	1.3	—	—	—	—	—	
Barley ( <i>Hordeum</i> )	tr.	tr.	0.3	—	0.1	4.4	5.4	11.4	11.9	6.6	
Oats ( <i>Avena</i> )	—	—	—	—	—	1.7	2.4	8.1	14.1	3.9	
Flax ( <i>Linum</i> )	—	—	—	—	—	1.0	1.5	0.7	0.3	1.2	
Millet ( <i>Setaria</i> )	—	—	—	—	—	0.1	0.3	1.2	1.6	0.7	
Other crops	—	—	—	—	—	1.5	0.6	0.3	0.8	0.7	
Totals	86.2	75.2	65.1	63.3	73.0	80.9	86.0	75.8	79.1	81.7	
Non-crops											
Foxtail ( <i>Setaria</i> )	3.6	0.9	0.9	21.5	3.4	3.4	0.9	1.3	4.1	2.7	
Dayflower ( <i>Commelina</i> )	0.7	7.9	17.5	—	8.4	—	—	—	—	—	
Bur-cucumber ( <i>Sicyos</i> )	0.4	4.3	2.6	0.3	2.4	—	—	—	—	—	
False buckwheat ( <i>Polygonum</i> )	0.2	2.6	1.5	tr.	1.4	—	—	—	—	—	
Sunflower ( <i>Helianthus</i> )	1.2	tr.	0.1	tr.	0.3	4.5	0.2	0.1	1.7	2.4	
Miscellaneous seeds	5.8	8.4	9.8	8.0	8.3	1.9	2.6	0.7	1.5	2.0	
Totals	4.9	15.6	22.5	21.8	15.6	5.2	1.8	12.8	9.3	5.4	
Miscellaneous foliage	—	—	—	—	—	4.5	6.8	6.5	3.7	4.5	
Animal materials											
Grasshoppers ( <i>Orthoptera</i> )	1.9	tr.	tr.	1.0	0.6	2.6	1.2	1.1	4.7	2.3	
Ground beetles ( <i>Carabidae</i> )	0.6	tr.	tr.	0.3	0.2	0.1	0.1	2.3	0.7	0.5	
Caterpillars ( <i>Lepidoptera</i> )	—	tr.	0.1	0.2	0.1	—	—	4.2	0.2	0.7	
Crickets ( <i>Gryllidae</i> )	—	—	—	—	—	0.4	tr.	0.3	1.4	0.5	
Ants ( <i>Formicidae</i> )	tr.	tr.	0.4	1.2	0.2	tr.	—	1.7	0.4	0.3	
Other animal materials	tr.	tr.	0.4	1.9	0.7	0.3	0.6	3.2	1.8	1.1	
Totals	2.5	tr.	0.9	4.5	1.5	3.5	1.8	12.8	9.3	5.4	
Mineral matter (grit)	0.1	0.2	0.4	1.5	0.4	0.5	1.6	2.6	0.5	1.1	

<sup>1</sup> Adapted from data provided by Korschgen (1964).

<sup>2</sup> Adapted from data provided by Trautman (1952); monthly means converted to seasonal means without adjustment for minor sample size variations.

**Table 13.** Major foods (percentage composition) of juvenile ring-necked pheasants

	Age in weeks (Ontario) <sup>1</sup>					Month of sample (S. Dak.) <sup>2</sup>			
	1-3	4-6	7-9	10-12	Total	July	August	September	Total
Sample size	61	82	90	18	251	57	67	72	196
<i>Animal materials</i>									
<i>Arthropods</i>									
Ephemera	41.3	31.4	5.4	0.2	19.4	—	—	—	—
Orthoptera	0.6	1.2	1.7	1.9	1.3	36.3	27.3	18.8	23.3
Trichoptera	4.3	3.3	2.1	4.3	3.5	—	—	—	—
Lepidoptera	14.0	3.0	1.0	0.4	4.6	tr.	0.2	0.5	tr.
Coleoptera	1.2	0.4	0.4	0.4	1.8	tr.	1.0	3.0	1.9
Others	34.1	7.1	2.8	0.9	10.2	tr.	6.6	0.2	3.0
Molluscs	2.5	0.4	0.8	0.4	1.0	—	—	—	—
<b>Totals</b>	<b>98.0</b>	<b>46.8</b>	<b>14.2</b>	<b>8.5</b>	<b>41.8</b>	<b>36.3</b>	<b>35.1</b>	<b>22.5</b>	<b>28.2</b>
<i>Plant materials</i>									
Grains	1.8	35.1	39.7	45.6	30.5	50.7	48.8	51.3	50.3
Seeds	0.2	6.4	19.1	22.3	12.0	3.4	13.7	34.3	17.5
Fruits	—	9.4	19.5	16.8	11.4	—	—	—	—
Foliage	tr.	2.2	7.5	6.8	4.1	9.2	1.6	1.2	2.8
<b>Totals<sup>3</sup></b>	<b>2.0</b>	<b>53.1</b>	<b>85.8</b>	<b>91.5</b>	<b>58.1</b>	<b>63.1</b>	<b>64.1</b>	<b>76.8</b>	<b>70.6</b>

<sup>1</sup> Data derived from weekly totals of Laughrey and Stinson (1955).<sup>2</sup> Data adapted from Trautman (1952).<sup>3</sup> Excluding mineral matter (grit).

## 6 · Comparative mating systems and social signalling devices

### Mating systems

Reproductive strategies among the pheasants are in part a reflection of the relative anti-predator importance of maintaining a gregarious social structure through most of the year, which is typically the case with smaller, more vulnerable species such as blood pheasants and the closely related partridges, versus the need or opportunities for maximum spacing owing to limited environmental resources and/or relative security against predators. Generally, among pheasants there is a fairly close correlation between plumage dimorphism and reproductive strategy. Species that are sexually monomorphic tend to be monogamous, and often have somewhat extended pair bonds. However, those that are strongly sexually dimorphic both in overall body size and plumage development tend to be polygynous or promiscuous, forming either male-dominated harems if maintaining their sociality through much of the year, or establishing individual male display areas which individual females may visit and become fertilized when they are ready for breeding.

In the pheasants, as in the quails and grouse (Johnsgard 1973; 1983b), the general trends in reproductive strategies seem to have been ones that have resulted in evolutionary shifts from earlier monogamous pair-bonding systems to polygynous or promiscuous ones whenever ecological conditions have allowed. The evolution of non-monogamous mating has probably occurred more than once among pheasants, as suggested earlier (Johnsgard 1973, p. 122). The pheasant group may thus actually be of polyphyletic origin, and derived from those partridge species that have for the most part abandoned monogamous mating tendencies for polygynous or promiscuous ones.

Ridley (in press) has recently summarized a variety of ecological aspects of pheasant relative to their mating systems, and made a number of interesting observations and conclusions. He classified each of the pheasant genera as being either solitary or gregarious in social organization, and their mating systems as monogamous, polygynous or promiscuous. In his view, relative sociality in pheasants is largely related to habitat, since pheasants living or foraging

in open habitats are gregarious because of higher predation risks. Such species do not compete strongly for food during the breeding season since open-country species tend to be mostly herbivorous, while forest-dwelling pheasants are typically solitary, apparently to avoid severe competition for limited food sources.

The habitat also plays a strong role in shaping pheasant mating systems, according to Ridley. Among species that forage in open habitats the females are typically guarded by the males, thus tending toward the establishment of longer pair bonds. In edge habitats harem polygyny is characteristic, whilst in tropical forests the usual mating system is one of serial polygyny or promiscuity, the latter situation being promoted by the tendency toward asynchronous breeding cycles in tropical environments. Ridley considered the following genera characteristic of scrub and open grassland: *Ithaginis*, *Catreus*, and *Crossoptilon*. All of these exhibit whole-season pair-bonding and a lack of gregariousness among females. Genera he considered as forest-edge or scrub-edge species that forage in the open included *Gallus*, *Phasianus*, *Syrmaticus*, *Lophophorus*, and *Pavo*. In all of these genera the females tend to be gregarious, and pair-bonding may last as long as the entire season (*Gallus*), until incubation begins (*Phasianus*, *Syrmaticus* and *Lophophorus*), or only until fertilization (*Pavo*). The montane forest pheasant genera include *Pucrasia*, *Tragopan* and *Chrysolophus*. In all of these the females are solitary, with pair-bonding lasting only to incubation or (in *Chrysolophus*) only through fertilization. Lastly, the tropical forest genera include *Lophura*, *Polyplectron*, *Argusianus*, *Rheinartia*, and *Afropavo*. In all of these the females are non-gregarious, and in all but *Lophura* and probably *Afropavo* the mating systems are polygynous. *Afropavo* is exceptional in that apparently monogamous pair-bonding occurs and it evidently lasts through the breeding season. Since *Afropavo* is considered a generally very primitive form, this is presumably the result of a retention of this original trait, rather than a secondarily acquired characteristic.

The limited movements of most pheasants probably facilitate some remating with mates of previous



years, although in at least some species such as the common pheasant and the red junglefowl the high mortality rates among adults, especially males, are seemingly so severe that in relatively few instances would the same mates be available in successive years. In the forest-dwelling species loud male calling and the use of traditional territorial display areas probably serve as important cues for females to locate sexually active males. Apparently only in peafowl (*Pavo*) has a trend toward social display evolved that is somewhat comparable to the lek display grounds of various grouse, in which several males gather in close proximity for display and the female may select a single male from the group for mating (Morris 1957).

### Social signalling systems and sexual dimorphism

It is generally true that sexual dimorphism in the broad sense (including colour and plumage dimorphism, or 'dichromatism', and behavioural dimor-

phism, or 'diethism') tends to be highest in polygynous or promiscuous species of vertebrates, in line with generally accepted ideas on the effects of sexual selection on social signalling systems as related to their differential intersexual attraction and intrasexual dominance/fitness gradients. A summary (Table 14) of the situation in the 16 pheasant genera provides a limited degree of support for this general position. For example, it is true that the three genera of pheasants believed to have season-long monogamous pair-bonds all exhibit rather limited sexual dichromatism (and always are lacking in male iridescence) and have very low male:female adult weight dimorphism.

Among the polygynous and edge-adapted species the pattern is less clear. In this group the degree of sexual dichromatism is generally high, as might be expected both by the pair-bonding system and the ecological influences favouring bright male signal coloration in an open environment. However, the range of estimated male:female weight ratios is

**Table 14.** Relationship of pair-bonding systems to sexual dimorphism in pheasants

	Sexual dichromatism	Male : female weight ratio <sup>1</sup>	Length of pair bond <sup>2</sup>
Monogamous open-country or scrub species <sup>2</sup>			
Blood pheasant	Moderate	1.1	Entire breeding season
Eared pheasants	Slight	1.1–1.2	Entire breeding season
Cheer pheasant	Slight	1.2–1.3	Entire breeding season
Polygynous edge-adapted species			
Junglefowls	Moderate	1.4–1.7	Entire breeding season (harem polygyny)
Typical pheasants	Moderate	1.2–1.6	To incubation (harem polygyny?)
Monals	High	1.1	To incubation (territorial polygyny?)
Long-tailed pheasants	Moderate	1.3–1.5	To incubation (territorial polygyny)
Monogamous forest species			
Congo peacock	Slight	1.2	Entire breeding season
Koklass	Moderate	1.3	To incubation (?)
Tragopans <sup>3</sup>	Moderate	1.0–1.7	To incubation (?)
Polygynous/promiscuous forest species			
Peacock pheasants	Variable	1.3–1.4	To incubation (?) <sup>4</sup>
Gallopheasants	Moderate	1.1–1.4	To incubation (?) <sup>4</sup>
Ruffed pheasants	High	1.1	Mating only (?)
Crested argus	High	?	Mating only
Great argus	High	1.4–1.5	Mating only
Peafowl	High	1.5	Mating only

<sup>1</sup> Based on weight data in the species accounts.

<sup>2</sup> In part after classification of Ridley (in press).

<sup>3</sup> Considered as polygynous by Ridley (in press).

<sup>4</sup> Some species are seemingly monogamous.

rather high, from 1.1 to 1.7, and indeed seems to be highest in the forms with the least dichromatism and lowest in those with the greatest dichromatism. Perhaps in some of these forms there has been sexual selection favouring large male size and associated territorial or peck-order dominance, while in others such as the monal the primary selective influence may have been on the development of sexually attractive male signalling devices and behaviour.

The two apparently monogamous forest-dwelling pheasants pose some uncertainties. Both show limited amounts of sexual dimorphism and both generally have dark plumage coloration, with no brilliant facial skin engorgements, combs, or wattles. Their degree of territoriality is unknown, but neither species is believed to defend and advertise large territorial areas. The length of the pair-bond is still uncertain in the Congo peacock and information on its adult weight ratio is still inadequate.

Among the polygynous or promiscuous forest-dwellers there are a few surprises. Thus, the ruffed pheasants seem to have a surprisingly small disparity in male:female weight ratios, which appear to be no greater than those of the monogamous species. However, their actual degree of polygyny and length of contact with females under natural conditions is still uncertain. The peacock pheasants likewise have a considerable diversity in plumage dichromatism, being slight in the bronze-tailed pheasant in particular, and perhaps highest in the Palawan peacock pheasant. Quite possibly this group also exhibits variations in pair-bonding tendencies that have yet to be determined in the field. Certainly the crested argus, great argus, and peafowl exhibit the combination of extreme male:female weight ratios, male plumage elaboration, and highly elaborated male displays that are to be expected in promiscuous species. Adult weight data are still unavailable for the crested argus, but in the other species the females tend to be only about two-thirds the size of the males, or approaching the 2:1 ratio that is found in some large lek grouse such as sage grouse and capercaillies (Johnsgard 1983b).

### Evolution of specific male signalling devices

The pheasant group is relatively consistent in its exploitation of only a relatively few types of signals for sexual attraction and/or male-male agonistic interactions. These signals have been briefly mentioned in earlier chapters, and at this point it is perhaps of interest to concentrate on a few that appear to be of virtually universal occurrence and importance in the pheasants. These include tidbitting, waltzing, and double wing-lowering, or frontal display.

Other displays, such as facial engorgement, tail-shaking or head-shaking, and wing-flapping, are of relatively similar form throughout the group, and their differential development patterns are fairly self-evident.

Tidbitting is an extremely important social display in pheasants, and as Schenkel (1956-58) has pointed out it is of special interest because in most pheasants the same or similar behaviour serves as an important food-showing device between females and their chicks, while in adults a ritualized version of this activity becomes a releaser for female sexual behaviour, or at least directs her attention to males that may be performing it. In some species the original food-showing function completely disappears, as in *Pavo*, where the display occurs in the absence of actual food. There the function of the behaviour seems to be largely concerned with 'luring' the female into a favourable position so that the maximum visual effect of the males posturing can be projected toward the female. Tidbitting behaviour is widespread in the Galliformes (Stokes and Williams 1972).

The ambivalent motivational origin of the waltzing display has already been discussed, at least with reference to the red junglefowl, and it is highly likely that this explanation is of general applicability among pheasants. The nearly universal occurrence of waltzing in pheasants helps to account for some aspects of their male plumage signals, such as the great visual importance of the upper back and rump coloration, which is typically exposed during waltzing. Likewise pheasants show a tendency toward lateral tail-spreading but usually not the extreme tail-cocking that often occurs in grouse, and in that group is associated with frontal rather than lateral display. On the other hand, underpart colouration in pheasants is less likely to be brilliant, and bright patterning or colouration is more likely to occur on the wing-coverts than on the remiges themselves, since typically it is only the primaries on the side opposite the 'target' bird that droop fully to the ground and thus do not provide great opportunities for concentration of effective visual signals.

Although in the gallopheasants, ruffed pheasants, typical pheasants, and long-tailed pheasants the predominant male orientation during intense display is lateral, an interesting trend away from a lateral display and towards a frontal orientation becomes evident in the peacock pheasants, and reaches its developmental peak in the great argus and typical peafowl. In the bronze-tailed pheasant, for example, the major male sexual display is a stationary lateral waltzing-like orientation with strong lowering of the near wing but almost no tilting of the tail and upper back toward the female. In that species irides-

cent colour is wholly lacking on the back and only poorly developed on the tail. In the Rothschild's peacock pheasant a much stronger degree of back-tilting and tail-spreading is apparent, and there is a correspondingly greater development of iridescence on the back, wing-coverts, and tail. In the grey and Germain's peacock pheasant a shift toward a frontal orientation during intense display is evident. In these species the tail is relatively more rounded than pointed and the entire dorsal body and wing-covert surface is studded with iridescent ocelli. The Bornean peacock pheasant and Palawan peacock pheasant also exhibit rounded tails and somewhat intermediate postural tendencies. The Bornean species has an extremely well developed lateral display, and only rarely uses a full frontal display (judging from limited observations). Similarly the Palawan peacock pheasant has evolved a spectacular lateral display with extreme tail-spreading and tail-tilting that emphasizes both the dorsal body and tail

colouration as well as retaining a clear view of the side of the head and eye, which form a point of strong visual focus for the overall display. In the great argus sexual display becomes fully frontal in its orientation. However, in this species the head is oriented laterally and the eye remains visible, again being situated in the optical centre of a spectacular series of radiating 'eyes' that extend radially outward along the ornamental secondary feathers. Finally, in the peafowl the role of the wings is taken over by the tail-coverts, which form a similar breathtaking array of 'eyes' that radiate out from the head and iridescent mantle during full frontal display. The plain-coloured remiges and rectrices are completely hidden between the train of iridescent tail-coverts, although periodic vibration of the rectrices produces a shimmering optical effect on the iridescent train, and the primaries are rhythmically lowered to the ground and are sometimes scraped along the ground surface.



## 7 · Reproductive biology

In most species of pheasants the breeding season is distinctly seasonal, and is typically associated with the spring months in the temperate regions or with wet season in more tropical areas. Even in relatively temperate areas, such as the northern states and prairie provinces of North America, the nesting season of ring-necked pheasants is often prolonged, with hatching dates often extending over a span of three or four months, as a result of renestings by females that were unsuccessful with their first clutch. Wagner *et al.* (1965) reported that during the period 1946–1956 in Wisconsin the average annual hatching date varied only to a minor degree between years, always falling between 12 and 21 June, but the total range of 5985 estimated hatching dates varied from mid-April to the end of August, a 21-week spread. They suggested that although the start of pheasant nesting varies somewhat from year to year, the onset of egg-laying is relatively fixed, and thus the incidence of 'dump-nesting' (in which eggs may be deposited by several females but incubated by none of them) may vary from year to year. They suggested that the phenology of egg-laying may be set by certain rather fixed environmental controls such as photoperiod, while nesting and brooding behaviour may be influenced by more annually variable environmental factors such as springtime temperatures.

Average clutch sizes in the pheasants vary greatly in average number between species, with relatively large clutches being typical of such grain-eating, edge or open-country adapted forms such as *Phasianus* and *Gallus*, and small clutches, of as few as only two eggs, being found in forest-dwellers such as *Polyplectron* and *Argusianus*. Evolved clutch-size is presumably largely a reflection of the average amounts of food available to the female around the time of nesting (Lack 1968). In general, phasianids that have clutches of only two to four eggs tend to lay eggs that are proportionately larger than the average for the family, while those with clutches of ten or more have proportionately smaller eggs than the average for the family, based on Lack's studies. However, he also noted that although species laying actually larger eggs tend to have longer incubation periods, those that lay proportionately large eggs relative to their adult weight do not have noticeably longer incubation periods. At least in two genera (*Tragopan* and *Argusianus*) the evolution of a pro-

portionately large egg seems to be correlated with the fact that the chicks are unusually precocial at the time of hatching, which may be of considerable ecological significance in some habitats.

Incubation periods among the pheasants range in length from 18 to 29 days, with the longer ones typical of such genera as *Argusianus*, *Pavo*, *Lophophorus*, and *Crossoptilon*, while periods of less than 23 days occur in forms such as *Pucrasia*, *Chrysolophus*, and *Polyplectron*. In most species incubation begins with the last egg, and thus hatching is essentially synchronous. In all cases only the female incubates, and in a considerable number of species it is known that she will usually lay a second clutch following the loss of the first. The eggshells are left in the nest at the time of hatching, and the young are taken away from the nest site shortly thereafter. In a few species (*Tragopan*, *Rheinartia*) the young attain a limited flying ability when only a few days old, while in others the flight feather growth is relatively slower and fledging may require a week or more. Thus, in the common pheasant flight is attained initially at about 12 days, and this is probably fairly typical for many species of pheasants (Cramp and Simmons 1980). In most species adult plumage and sexual maturity is attained the first year, but in some genera two (*Tragopan*, *Lophura*, etc.) or even three (*Pavo*, *Rheinartia*, probably *Argusianus*) years may be required before the adult male plumage and maximum breeding capabilities are attained.

### Reproductive success and recruitment rates

Determination of the overall reproductive success of any animal species is a complex process, since it is dependent upon a large number of variables that are not only difficult to measure but also may well vary from year to year or from place to place. Perhaps the simplest method of estimating overall annual reproductive success of a species is a determination of the fall or early winter recruitment rate (percentage of juvenile birds in the population), for it is the end-product of all the individual reproductive variables, such as clutch-size, age of initial breeding, nesting success, hatching success, rearing success, etc. Furthermore, since mortality rates of pheasants are believed to be fairly constant with age by the end of their first year, the recruitment rate should closely approximate the annual adult mortality rate in a

population that is essentially stable. Recruitment rates have the further advantage of being relatively easy to estimate, at least in those species of pheasants that can be legally hunted, since only a simple determination of the percentage of young birds in the autumn harvest is necessary for this determination. In the North American ring-necked pheasant population the age ratios have been found to vary considerably, but average about 60 per cent young of the year (Table 15) which is reasonably close to the average estimated female adult mortality rate of 66 per cent cited in an earlier chapter (Chapter 5). Male mortality rates of pheasants in North America average considerably higher than this, since game management practices in North America have been to harvest the maximum number of males possible, in the belief that a relatively few males are necessary in the population to maintain fertility among females. Data from Denmark also suggest that there male pheasants suffer a considerably higher mortality rate of approximately 78 per cent annually, as compared to a female annual mortality rate of about 62 per cent (Paludan 1959).

In Table 15 a summary of the major variables and parameters of reproduction in the North American ring-necked pheasant population is provided, based on a variety of studies from nearby parts of the species' North American range. A limited amount of comparable information is available from other parts of the species' range as well. Thus in England a

61 per cent nesting success rate (of 345 nests) and an 83 per cent hatching success (of eggs in 210 nests) were estimated (Cramp and Simmons 1980). Both of these statistics are fairly close to the North American figures. There seems to be little published information on age ratios in wild European pheasant populations, but in Denmark the mean annual mortality of all birds was estimated to be 81.4 per cent the first year, and 58.4 per cent in following years (Paludan 1959). These data suggest that fall recruitment rates probably range between 60 and 80 per cent in Denmark, or quite close to those reported for North America.

The data summarized in Table 15 suggest that although the overall nesting success is typically fairly low, an average of more than half of the females in the studies cited eventually succeeded in hatching broods, indicating a strong renesting capability in ring-necked pheasants. Indeed, on average it would seem that most unsuccessful females in these studies must have renested at least once (2.2 estimated average nests per female) in order to account for the differences between overall nesting success and overall ultimate female success in bringing off broods. It is known that up to three renestings are possible in the wild, following the loss of the first clutch (Dumke and Pils 1979). Under captive circumstances individual females have been known to lay up to as many as 140 eggs, with second and third-year females generally having higher reproductive

**Table 15.** Some reproductive parameters of wild ring-necked pheasant populations

	Range	Average <sup>1</sup>	Source
Overall nesting success	15–46%	26.4%	8 studies cited by Gates and Hale (1975)
Per cent of females hatching broods	43–88%	57.6%	8 studies cited by Gates and Hale (1975)
Per cent of eggs fertile	89–95%	92.9%	8 studies cited by Gates and Hale (1975)
Per cent of fertile eggs hatching (in successful nests)	85–96%	90.7%	8 studies cited by Gates and Hale (1975)
Per cent of all eggs hatching (in successful nests)	75–91%	84.8%	10 studies cited by Gates and Hale (1975)
Per cent of nests destroyed by agricultural activities	0–74%	29.6%	16 studies cited by Wagner <i>et al.</i> (1965)
Per cent of nests destroyed by predation	3–78%	31.1%	16 studies cited by Wagner <i>et al.</i> (1965)
Number of young females in fall relative to spring female population	1.3–1.9	1.5	6 studies cited by Gates and Hale (1975)
Per cent increase in females from spring to fall	86–179%	115.7%	6 studies cited by Gates and Hale (1975)
Per cent increase in total population from spring to fall	134–227%	187.6%	6 studies cited by Gates and Hale (1975)
Per cent of young birds in total fall population	47–83%	59.7%	4 studies cited by Hickey (1955)

<sup>1</sup> Unadjusted for sample size variations in some cases.



capacities than first-year birds (Perkić and Leporati, cited in Glutz 1973). Gates and Hale (1975) indirectly estimated that 88 per cent of the females on their Wisconsin study area that were initially unsuccessful in hatching broods made a second nesting effort, although in that area the farming practices caused high nest mortality rates in late-nesting birds. It would thus seem that the length of the optimum breeding season might thereby become an important local factor influencing overall reproductive success in this species.

To provide some specific examples of field studies on the reproductive characteristics of ring-necked pheasants, two relatively comparable and unusually complete studies have been selected (Table 16) for a summary of these parameters. Although some aspects of reproduction, such as nesting and hatching success, are quite similar in these two studies, there are major differences in the individual sources of nest mortality, especially in so far as losses resulting from nest desertion and farm machinery are con-

cerned. It would seem that, by and large, locally high rates of individual sources of nest losses, whether by predation, weather, or human-related factors, can probably be adjusted for by re-nesting capabilities of the species, and that different areas having widely differing environmental characteristics might well have remarkably similar overall hatching success and recruitment rates as a result of the compensatory capabilities of the species' reproductive strategy.

### Reproduction and habitat relationships

A very large number of studies in North America have attempted to determine the kinds of nesting habitats most suitable for pheasants, and differential rates of habitat use during the reproductive season. Generally these studies have attempted to compare nesting usage of reproductive success in terms of particular 'cover types' or physical aspects of cover, such as its height, density, or configuration.

**Table 16.** Summary of two reproductive field studies on ring-necked pheasants

	Wisconsin <sup>1</sup>	Iowa <sup>2</sup>
Clutch production		
Total clutches	4120	533
Per cent incubated	81.1%	—
Total successful	1235	136
Per cent successful	29.9%	25.5%
Egg production		
Average clutch size (incubated clutches)	11.2	9.5
Average clutch (unincubated clutches)	5.6	—
Randomly laid eggs (per cent of total)	3.3%	—
Chick production		
Average eggs per successful clutch	11.1	9.5
Per cent of eggs hatching	90.7%	82.8%
Production rates		
Nesting success (all clutches)	30.0%	32.4%
Nesting success (incubated clutches)	36.9%	—
Hatching success (all eggs laid)	28.8%	—
Hatching success (all eggs in clutches)	29.8%	—
Clutches produced per female	1.8	—
Clutches incubated per female	1.4	—
Eggs produced per female	18.6	—
Per cent of females hatching chicks	52.8	—
Chicks produced per female	5.3	2.7
Sources of nest failures		
Failure attributed to farm machinery	40.5%	7.2%
Failure attributed to predation	39.2%	37.6%
Failure from nest abandonment	10.1%	50.8%
Failed from other or unknown causes	10.2%	4.4%

<sup>1</sup> Data derived from Gates and Hale (1975).

<sup>2</sup> Data derived from Baskett (1947).



One of the physical aspects of nesting that has received particular attention is the idea that nesting density or nesting success might vary with the width or area of the particular nesting habitat. Thus, Gates and Hale (1975) observed in Wisconsin that nesting densities were greater in wider and denser strips of cover, and earlier studies have suggested that actual nesting success might also be positively related to the width of the nesting habitat. Gates and Hale also reported that, although statistical significance fell somewhat short of acceptance, they believed that pheasants exhibited a probable preference for nesting in larger blocks of cover (10 acres or more) than in smaller ones. They found the lowest nesting densities in hayfields of less than 10 acres in area, and the highest densities in fields of 31–40 acres, with intermediate densities in hayfields of intermediate sizes.

An area of similar concern and attention has been the possible role of habitat 'edge' with respect to the placement and density of pheasant nests. Some early North American studies such as Hamerstrom's (1936) suggested that perhaps pheasants prefer to nest in locations fairly close to the edge of their chosen nest habitat, regardless of its actual area. However, more recent studies, as summarized in Table 17, have failed to substantiate this view, and instead suggest that there is no direct relationship to the placement of a nest and its distance from the edge of the habitat. This seems to be the case in areas of fairly high nesting densities, as in Minnesota, as well as in areas of much lower nesting density, such as California, judging from the data presented in Table 17.

The physical aspects of the nesting site, in particular associated cover density and cover height, do seem to represent important aspects of nest-site selection in ring-necked pheasants. Hamerstrom (1936) reported that female ring-necked pheasants often situate their nests in cover that provides partial to complete overhead concealment, and also reported that hatching success of wholly concealed nests tended to be slightly higher than the success he estimated for partially concealed or unconcealed nests. Hanson (1970) similarly reported that at least for early-nesting females, the vegetative life-form of the nesting cover seems to be critical, with the density or height of the plant positively influencing nest-site selection tendencies. He judged that these factors might influence temperature and humidity characteristics of the nest itself, as well as its relative visibility to predators. Yearly averages of plant heights around the nest sites averaged from 9.8 to 26.8 in., and average light penetration levels ranged annually from 9 to 30 per cent.

Perhaps in part because of their widely differing height and density characteristics, there tend to be widely differing levels of use of various vegetation types by nesting ring-necked pheasants, as summarized in Tables 18 and 19. As in many other North American studies, Gates and Hale (1975) found that in Wisconsin there were major differences in nesting densities, and less conspicuous differences in nesting success, associated with various nesting habitat types. They observed that wetlands, especially permanent wetlands, provided nesting cover that was associated with the highest average nesting success percentages. Wetland habitats were also associated

**Table 17.** Results of two studies of nest locations relative to edge in ring-necked pheasants

	Distance of nest from habitat edge (feet)				
	0–50	51–100	101–200	Over 200	Total
<b>Minnesota<sup>1</sup></b>					
Number of acres studied	200.3	158.2	198.1	87.3	643.9
Number of nests found	168	117	145	78	508
Per cent of total acreage	31.3	24.6	30.8	14.4	100
Per cent of nests found	33.1	23.0	28.5	15.4	100
Nests/100 acres habitat	84	85	73	89	79
<b>Ohio<sup>2</sup></b>					
Number of acres studied	683	601	889	310	2483
Number of nests found	124	114	157	56	451
Per cent of total acreage	27.5	24.2	35.8	12.5	100
Per cent of nests found	27.5	25.3	34.8	12.4	100
Nests/100 acres habitat	18	19	18	18	18

<sup>1</sup> Data of Nelson *et al.* (1960).

<sup>2</sup> Data of Strode (1941), recalculated where necessary for comparability.

with relatively high nesting densities, especially in the case of herbaceous wetlands. 'Strip cover', consisting of roadsides, fence lines, ditch-banks and similar kinds of cover essentially linear in orientation, also had fairly high nesting densities in some cases, particularly if measured on a somewhat misleading density-per-acre rather than nests-per-mile basis. Nesting density was found to be highest in woody and canary-grass types, and overall density apparently depended upon cover density and cover width more than upon other vegetational characteristics. Hayfield usage by pheasants on the other hand was largely influenced by phenology; early-nesting years or early-nesting birds were associated with higher use of wetlands for nesting, but in later-nesting years and later in the nesting season hayfields and cultivated fields of peas and grain become much more important nesting habitats. Thus, nest-site selection in pheasants is apparently a complex interplay between cover preferences, cover availability, and varying cover conditions as the nesting season progresses. In general it may be said that in ring-necked pheasants blocks of vegetation seem to be preferred for nesting over strips, and that comparatively low and dense cover associated with residual plant material in wetlands, or newly growing vegetation in hayfields or cultivated fields, is evidently also important in nest-site selection.

### Egg size and clutch size

Comparative sizes of eggs to adults in birds offer opportunities for various sorts of ecological analyses and some major points have already been made on this matter, based on Lack's (1968) studies. However, he had to rely on limited information on egg weights and adult weights and furthermore did not

discuss clutch weights as a significant ecological factor in reproductive biology of pheasants. Thus, I have recalculated relative egg weights for as many species of pheasant for which I could find suitable data, and have also calculated the average collective clutch weight relative to adult female weight as a measure of the physiological stress of reproduction in this group. The results are summarized in Table 20, with clutch weights calculated on the basis of midpoints between the ranges indicated in Table 21, and the species organized into mating system categories as used in Table 14.

There are few obvious correlations between mating systems and relative female energy investment in eggs or clutches evident in this summary, although the lack of reliable information on both average adult female weights and average clutch sizes in the wild tend to obscure some of the trends that might have been expected. Generally, it seems that monogamous species do not expend significantly different amounts of energy in individual eggs or collective clutches than do polygynous edge-adapted forms, with both groups typically laying eggs of from 3 to 6 per cent of the adult female's weight and producing clutches of from about 15 to 50 per cent of the female's weight. However, in the polygynous or promiscuous forest-adapted species there tend to be smaller clutch sizes (*Chrysolophus* being the major exception), relatively large egg sizes (especially in *Polyplectron*), and relatively low total energy investment in total clutches (particularly in *Polyplectron*, some *Lophura*, and *Argusianus*). Quite possibly these trends are related to the desirability of producing a few, fairly precocial offspring in a woodland environment having limited food resources for both the female and her chicks.

**Table 18.** Habitat relations to nest locations, hatching success, and relative chick production in ring-necked pheasants<sup>1</sup>

	Hayfields	Strip cover	Small grains	Wetlands	Pastures	Woodlands	Miscellaneous	Totals or average
Nest locations <sup>1</sup>	45.6%	20.3%	13.7%	5.5%	4.1%	1.9%	9.7%	100%
Hatching success <sup>2</sup>	20.9%	19.8%	38.5%	32.9%	28.5%	22.0%	21.5%	24.9%
Relative chick production <sup>3</sup>	10.0%	25.2%	45.0%	10.4%	6.1%	0.3%	3.2%	100%

<sup>1</sup> Derived from tabular percentage data of 12 studies summarized by Olsen (1977), with some recalculations where required.

<sup>2</sup> Derived from tabular percentage data of 11 studies summarized by Olsen (1977); mean hatching percentages estimated without adjustment for sample size variations, which often were unspecified. Overall hatching success calculated from only those studies with indicated sample sizes.

<sup>3</sup> Derived from tabular percentage data of 7 studies summarized by Olsen (1977); mean percentages estimated without adjustment for sample size variations, which were unspecified.



**Table 19.** Habitat influences on nest density and nest success in ring-necked pheasants<sup>1</sup>

	Number of nests	Nests/ 100 acres	Nest success (%)
Hayfields	—	—	14
Pastured hayfields	27	5	—
Mowed red clover hayfields	69	19	—
Mowed alfalfa hayfields	212	20	—
Unharvested hayfields	55	31	—
Wetlands	—	27	46
Herbaceous	49	68	—
Canary grass ( <i>Phalaris</i> )	62	33	—
Sedge meadow ( <i>Carex</i> )	145	23	—
Shrub swamp	9	10	—
Cattail ( <i>Typha</i> )	2	5	—
Temporary wetlands	24	29	—
Peas and small grains	—	1.5–9	31
		Nests/mile	
Strip cover			26
Roadsides	—	—	31
Grassy	50	1.1	—
Herbaceous	10	2.1	—
Sedge-canary grass	14	2.9	—
Woody	11	3.7	—
Fence lines		—	24
Grassy	31	0.6	—
Herbaceous	15	1.1	—
Woody	28	2.2	—
Ditch banks		—	20
Herbaceous	12	3.1	—
Canary grass	37	5.0	—
Woody	11	6.9	—

<sup>1</sup> Data derived from Gates and Hale (1975).

### Brood-rearing and juvenile mortality

The brood-rearing period is a critically important one in the lives of pheasants, for it is during the first few weeks of life that mortality rates are at their highest, and thus the success or failure of a species' local population may be determined by the weather and other environmental factors influencing mortality during these critical times of the year. Much has been made of these high juvenile mortality rates, and of the difficulties of determining their causes under natural conditions. Thus, Stokes (1954) stated that 'The disappearance of so many thousands of

chicks in the short space of a summer almost beneath one's eyes and yet not noticed is a baffling experience and an enigma still to be solved.' Estimates of the actual magnitude of these losses are quite variable, and are made more difficult because of strong tendencies toward brood amalgamation toward the end of the summer. Gates and Hale (1975) concluded that so many factors influence the sizes of observed broods in the field that such data are highly suspect as indices to annual juvenile mortality. They judged that broods coming from the early stages of the hatching season showed rather little tendency to combine in later life, while those hatching later in the summer exhibited a greater tendency for amalgamation. They concluded that the brood sizes of four to six-week old age classes provided the best estimates of actual juvenile mortality rates, and judged that rates of juvenile mortality between hatching and October 1 averaged about 42 per cent over a six-year period. Most other field studies in North America have made similar estimates of juvenile mortality rates that have ranged from 35 to 56 per cent, with most observers believing that the majority of the losses actually occur within a few days after hatching (Baxter and Wolfe 1973). During this vulnerable period the chicks are evidently highly sensitive to adverse weather effects such as chilling and wetting. Although some studies have positively correlated late-hatched broods with higher mortality rates, others have found that late-hatched broods instead tend to suffer lower mortality rates than do earlier ones (Baxter and Wolfe 1973). Information on other species is extremely limited, but Collias *et al.* (1966) judged that only 25 per cent of the chicks hatched among semi-feral red junglefowl in the San Diego Zoo survived until the time of family breakup, or an approximate 75 per cent mortality rate during the first two months of life. A further 76 per cent mortality rate occurred from that point to the end of their first year of life in this population. This is not very different from the estimated 81.4 per cent mortality rate of Danish pheasants in their first year of life (Paludan 1959), or the estimated 82.4 per cent annual mortality rate of juvenile radio-equipped pheasants in Wisconsin during their first year (Dumke and Pils 1973).

During their first year the juveniles are incorporated into the flock structure in the case of socially organized pheasants, or gradually disperse and begin to establish their own home ranges or territories in the case of the more solitary species. Depending upon the rate at which sexual maturity is attained, males may also begin advertisement behaviour during this first year.



**Table 20.** Relationship of egg weight and clutch weight to adult female weight in pheasants<sup>1</sup>

Ecological-mating type species	Estimated Egg wt. (g)	Estimated female wt. (g)	Egg wt. as % of female wt.	Clutch wt. as % of female wt.
Monogamous, open-country or scrub species				
Brown eared pheasant	44.5	1650	2.6	16.9
White eared pheasant	58.4	1600	3.6	19.8
Blue eared pheasant	52.1	1600	3.2	20.8
Blood pheasant	28.8	515	5.6	47.6
Cheer pheasant	71.6	1200	6.0	63.0
Average	—	—	4.2	33.6
Polygynous edge-adapted species				
Ceylon junglefowl	30.4	550	5.5	16.5
Elliot's pheasant	25.2	910	2.8	19.6
Himalayan monal	70.7	1950	3.6	21.6
Common pheasant	32.2	1025	4.5	33.8
Mikado pheasant	46.2	1015	4.5	33.8
Red junglefowl	29.6	500	5.9	35.4
Reeves' pheasant	34.8	950	3.7	37.8
Average	—	—	4.1	27.9
Monogamous (?) forest species				
Blyth's tragopan	62	1250	5.0	15.0
Western tragopan	61.3	1325	4.6	16.1
Satyr tragopan	63.3	1100	5.7	17.1
Temminck's tragopan	47.7	1035	4.6	18.4
Koklass	40	932	4.3	25.8
Average	—	—	4.8	18.5
Polygynous/promiscuous forest species				
Great argus	74.3	1600	4.6	9.2
Germain's peacock pheasant	30.4	400	7.6	15.2
Grey peacock pheasant	37.3	480	7.8	15.6
Edwards' pheasant	32.3	1050	3.1	17.1
Crestless fireback	33.2	840	3.9	17.5
Crested fireback ( <i>ignita</i> )	47.6	1600	3.0	18.0
Silver pheasant ( <i>nycthemera</i> )	42.8	1150	3.7	18.5
Indian peafowl	103.5	3375	3.1	18.6
Palawan peacock pheasant	32.2	320	10.0	20.0
Wattled pheasant	45.3	1130	4.0	22.0
Lady Amherst's pheasant	31.1	700	4.4	39.6
Golden pheasant	28.1	600	4.7	42.3
Kalij ( <i>melanota</i> )	37.4	890	4.2	50.4
Average	—	—	4.9	23.4

<sup>1</sup> Organized by increasing relative clutch weight to female weight within ecological-mating categories; adapted from Ridley (in press).

## 8 · Aviculture and conservation

### Pheasants as avicultural subjects

There are so many excellent references on pheasant-keeping (Gerrits 1974; Delacour 1978; Howman 1979; Roles 1981) that it seems unnecessary to review detailed techniques of pheasant aviculture. Nevertheless the role of aviculture in the propagation and preservation of endangered species, and the potential for aviculture to introduce pheasant populations into new areas or back into areas from which they have previously been eliminated is so great that no discussion of pheasant biology would be complete without some reference to these matters.

Howman (1979) has made the interesting point that pheasant-raising is perhaps the only branch of aviculture in which one can currently buy a pair of an endangered species of bird for a very modest amount of money, breed it, and perhaps produce offspring. Many of the eighteen rare, vulnerable or endangered species of pheasants are fairly easily available from aviculturists, and nearly all of these can be bred under favourable avicultural conditions. It is indeed important that as many separate and dispersed collections of rare pheasants be kept as possible, in order to reduce the danger of disease or other local calamity destroying the entire gene pool of a captive flock. Large numbers of birds in captivity also help to maintain a diversified gene pool, which is of considerable importance if fertility is to be maintained and the lines are not seriously to drift away from the original genetic make-up of the species.

Keeping pheasants does require considerable aviary space if the birds are to be effectively maintained and bred, and Howman suggests that about 200 ft per pair is a reasonable aviary design. For some highly herbivorous species such as the koklass a grassy floor may be desirable, but the dangers of such parasites as gapeworms (*Syngamus*) must be considered as well, and thus some aviculturalists may prefer wire-mesh floors over natural substrates. All aviaries require protection from terrestrial and aerial predators, and depending upon the climate may also require protection from the elements. The latter is especially important for some delicate and tropical-adapted forms. Control for photoperiod may also be needed for species that are being maintained at latitudes well away from their normal range.

Most of the diseases of pheasants are the same ones that attack domestic fowl, turkeys and similar

poultry, and thus a variety of treatments are available for most species. Similarly, the vast majority of pheasant species are able to consume the standard poultry rations that are widely available, and these are generally of very high quality and provide well-balanced nutrition. Some species that naturally consume large quantities of insects in the wild may require additional feeds of mealworms or other insects, and virtually all pheasant chicks can be stimulated to feed most effectively by providing such live food. Highly herbivorous species, such as the koklass and tragopans, greatly profit from such green foods as lettuce, lucerne (alfalfa), or even fresh grass clippings, and fruit or nuts such as peanuts are often particularly attractive to most pheasant species as well. Finally, a source of grit is important, especially for the species in which grass or other cellulose-rich vegetation forms an important component of the diet.

Incubation of pheasant eggs can be done by bantam breeds of domestic fowl, or by commercial incubators of the type used for domestic fowl, turkeys, and the like. Collecting the eggs as they are laid normally results in the laying of a second clutch, which may also be removed and incubated separately, or perhaps left with the female to incubate on her own. Continued collection of eggs will often stimulate the laying of a much larger number of eggs than ever occurs in the wild, but brings with it some risk of reproductive stress on the female. However, since female ring-necked pheasants have been known to lay more than 100 eggs in a year, and domestic fowl more than 300, the dangers of this are probably not great provided that a fully adequate diet is maintained throughout the egg-laying period.

Wayre (1969) has discussed the role of aviculture in ensuring the survival of rare endangered species of pheasants, and in particular described the role of the Pheasant Trust in reintroducing the endangered Swinhoe's pheasant back to the island of Taiwan, where it has been in the danger of extinction. After beginning a captive breeding programme in 1959, more than 150 birds of this species were produced, and in 1967 15 pairs were taken back to Taiwan and released in a protected area of forest. The following year six more pairs were released in the same area. A similar project was undertaken with the mikado pheasant, an endangered species that is also of very limited occurrence on the island of Taiwan. A



breeding project for that species resulted in the production of 140 young during 1969, and plans have been made for the release of some of these birds as well. Finally, the Trust sent 12 captive-bred pairs of cheer pheasants to India in 1971, for release near Simla in Himachal Pradesh. An additional group of 24 birds were sent to the same area in 1973, and the species now occurs in the wild not far from that original point of release (*Norfolk Wildlife Park and Pheasant Trust Annual Report* 1980, p. 76).

Of similar interest are the efforts of the Jersey Wildlife Preservation Trust in breeding the vulnerable white eared pheasant, from two pairs of this species obtained from China via Russia in 1966. After an initial breeding in 1969 by the single pair still surviving then, with the rearing of 13 birds, 22 more were raised during 1970 and 1971. More recent breedings have substantially increased this number (Mallinson and Taynton 1978; Mallinson 1979), and as of 1979 the breeding programme had resulted in a net population increase of 162 white eared pheasants. Similar efforts of the Jersey Wildlife Preservation Trust have been directed toward the Edwards' pheasant and the brown eared pheasant, and have resulted in more modest increases in the captive numbers of these two endangered or vulnerable species.

A major project involving the preservation and reintroduction of the endangered cheer pheasant has been undertaken jointly by the World Pheasant Association and the Game Conservancy; the project resulted in the production of 500 eggs of this species in 1978 and 1979 (Beer and Cox 1981). Some cheer pheasants have been released in the Margala Range of Pakistan as a result of these activities (Mirza, 1981b), although the results of these efforts are still not very evident.

In Table 21 a summary of the major reproductive parameters of all the pheasant species is provided, based primarily on avicultural information. Frequently the indicated time to full reproductive maturity is longer than that required to attain the adult plumage, and it is also true that species which normally breed only in their second year of life will occasionally attempt to breed their first year, albeit generally without high success. There is relatively little information available on the effective breeding lifetime of pheasants, but even in the wild common pheasants have been known to survive for almost eight years, and have survived even longer in captivity.

As an indication of the potential longevity of various pheasants under captive conditions, some examples of extreme longevity that were mentioned by Mitchell (1911) might be cited, remembering that these records were obtained well before modern

methods of feeding and housing had been perfected. The maximum captive longevity that he cited for any species of pheasant was 179 months for the grey peacock pheasant, followed by 163 months for great argus, 161 months for kalij, 148 months for grey junglefowl, 133 months for Blyth's tragopan, 123 months for Temminck's tragopan and Himalayan monal, 116 months for crested fireback, 114 months for silver pheasant, and 109 months for crestless fireback. Several other species (golden pheasant, Lady Amherst's pheasant, copper pheasant) were also reported as surviving in excess of 90 months in captivity. It is of interest that many of the species with unusually long captive lifespans (great argus, peacock pheasants and tragopans) are ones that have correspondingly low reproductive potentials in the wild. Quite possibly these long captive lifetimes are reflections of adaptations associated with a relatively long lifetime under wild conditions. Likewise; Delacour (1977) reported that one captive crested argus survived nearly 20 years in his collection, which is an example of another long-lived species having a very low reproductive potential in conjunction with a small clutch size and a delayed reproductive maturity.

#### **Captive status of rare and endangered pheasants**

Since its inception in 1975 the World Pheasant Association has been concerned with all aspects of pheasant conservation, and in particular the role of aviculture in maintaining breeding stocks of the world's rare and endangered species of Galliformes. At various intervals this group has surveyed the galliform holdings of private and institutional collections around the world, and has published its results in the *World Pheasant Association Journal* and in its own newsletters. Table 22 provides a summary of the Association's findings, at least for all the 18 rare, vulnerable and endangered species of pheasants, and for each of the three censuses that have thus far been made by the World Pheasant Association. The first two of these were published in the *World Pheasant Association Journal*, 1, 78–81. and 4, 72–75. The most recent is yet to be published formally.

These very interesting data provide a valuable index to the captive status of all the species of rare pheasants, as well as some idea of the trends in these captive populations over the past six years. It is quite probable that captive numbers of pheasants are now at the highest level in history, and certainly avicultural methods for maintaining the breeding pheasants are constantly improving. Thus, a brief summary of the captive status of each of these species is provided here. A more general statement about the species' status in the wild and prospects



**Table 21.** Some reproductive parameters of pheasants in captivity<sup>1</sup>

Species	Years to sexual maturity	Clutch size	Incubation period (days)	Total in captivity <sup>2</sup>
Blood pheasant	1	5–12	27–28	18
Western tragopan	2	3–6	28	few
Satyr tragopan	2	2–4	28	791
Temminck's tragopan	2	2–6	28	340
Blyth's tragopan	2	2–4	28?	9
Cabot's tragopan	2	2–4	28	50
Koklass	1	5–7	26–27	509
Himalayan monal	2	4–8	28	1374
Sclater's monal	?	?	?	0
Chinese monal	2?	3–5?	?	few
Green junglefowl	1–2	4–6	21	82
Red junglefowl	1–2	4–8	19–21	1072
Grey junglefowl	2	4–8	20–21	432
Ceylon junglefowl	2	2–4	20–21	213
White eared pheasant	2	4–7	24–25	434
Blue eared pheasant	2	5–8	26–28	977
Brown eared pheasant	2	5–8	26–27	564
Salvadori's pheasant	2?	2	21–22	23
Imperial pheasant	2	5–7	25	24
Edwards' pheasant	1	5–6	24–25	690
Kalij	1	9–15	24–25	937
Silver pheasant	2	4–6	25–26	2453
Swinhoe's pheasant	2	6–12	22	1657
Siamese fireback	2–3	5–8	24–25	690
Crestless fireback	2	3–6	23–24	162
Crested fireback	2–3	4–8	24	598
Wattled pheasant	2	3–8	24–26	59
Cheer pheasant	1	9–12	26	463
Reeves' pheasant	1	7–14	25	2097
Copper pheasant	1	6–12	25	528
Bar-tailed pheasant	1	6–11	27–28	527
Elliot's pheasant	1	6–8	25	847
Mikado pheasant	1	5–10	27	532
Common pheasant	1	8–12	24–25	millions
Green pheasant	1	8–12	24–25	298
Golden pheasant	2	6–12	22	5584
Lady Amherst's pheasant	2	6–12	22	3419
Bronze-tailed pheasant	2?	2	22	147
Rothschild's peacock pheasant	2	2	22	few
Grey peacock pheasant	2	2	22	853
Germain's peacock pheasant	2	2	22	249
Malayan peacock pheasant	2	1	22	77
Bornean peacock pheasant	2	1	22	few
Palawan peacock pheasant	2	2	18–19	499
Crested argus	3	2	25	0
Great argus	3	2	24–25	281
Indian peafowl	3	4–8	27–29	3267
Green peafowl	3	4–6	28	460
Congo peacock	1–2	2–3	26–28	67

<sup>1</sup> Adapted primarily from information in Delacour (1977) and Howman (1979).<sup>2</sup> 1982 World Pheasant Association census.

**Table 22.** Summary of known world captive populations of rare and endangered pheasants<sup>1</sup>

	World Pheasant Association census totals		
	1976	1979	1982
<b>Endangered species</b>			
Western tragopan	0	2	0
Cabot's tragopan	12	19	50
Chinese monal	0	0	0
Brown eared pheasant	871	679	564
Cheer pheasant	838	705	463
Elliot's pheasant	1537	1038	847
<b>Vulnerable species</b>			
White eared pheasant	201	346	434
Edwards' pheasant	635	664	690
Imperial pheasant	21	27	24
Swinhoe's pheasant	1693	1460	1657
Wattled pheasant	31	36	59
Mikado pheasant	1173	666	532
Palawan peacock pheasant	364	315	499
Green peafowl	499	315	460
<b>Rare species</b>			
Blyth's tragopan	6	9	9
Sclater's monal	0	0	0
Bar-tailed pheasant	876	626	527
Crested argus	0	0	0

<sup>1</sup> Rarity classification based on *ICBP Bird Red Data Book* (King 1981).

for its conservation will be found in the individual species accounts of the following section.

#### *Western tragopan*

Efforts are under way in both Pakistan and India for the propagation and eventual replanting of this endangered species. In the late 1970s facilities for hatching and rearing these birds were established in Pakistan, and field studies were also begun. A similar programme was begun in Himachal Pradesh in 1978 (King 1981). There are no breeding birds in Europe or North America at the present time.

#### *Cabot's tragopan*

Although the Cabot's tragopan was once fairly common in captivity in Europe, its stocks declined after the First World War (King 1981). During the 1960s and 1970s a few birds reached England, and likewise several have recently reached the United States, where Mr Charles Siville of Long Island has made a special effort toward breeding them and building up a captive population of this endangered species.

#### *Chinese monal*

This species has been maintained in captivity only very rarely, and has never been known to breed in the western world. A few were present in the Peking Zoo in the early 1970s, but all of these had died by 1976 (King 1981). However, the Chinese recently obtained more wild stock, and in the spring of 1983 a pair of these endangered birds were sent to the San Diego Zoo by the Chinese government, in hopes that a captive breeding stock can be developed.

#### *Brown eared pheasant*

Although a rather large number of brown eared pheasants are in captivity, all of those outside China as of 1976 were descended from the original three importations. However, additional birds were sent from China to the Pheasant Trust in 1976, from which offspring have been produced (Mallinson 1979). More recently, wild-stock birds have also been sent to the San Diego Zoo from China, thus improving the genetic diversity of the captive population.

#### *Cheer pheasant*

Like the Cabot's tragopan, this endangered species was common in captive collections until the First World War, after which stocks declined. However, since 1933 the numbers have gradually grown, in large measure as a result of efforts of the Pheasant Trust and the World Pheasant Association. As noted earlier, there have also been some releases of captive-bred birds back into the wild.

#### *Elliot's pheasant*

The Elliot's pheasant was first bred in captivity in 1880, and since then has always been fairly frequently seen in captivity. However, since 1960 the only additions of wild-trapped birds to the stocks in captivity have been two males sent to the Pheasant Trust in England in 1974, and a male in Hong Kong in 1976 (King 1981). Since 1980 several additional birds have come to the San Diego Zoo from Chinese sources.

#### *White eared pheasant*

White eared pheasants were not bred in captivity until 1938, and have always been relatively rare in collections. Two pairs were received by the Jersey Wildlife Federation Trust in 1966, and others were sent to the Antwerp Zoo and the East Berlin Zoo (Tierpark Berlin). As mentioned earlier two pairs were also received by the Pheasant Trust in 1974. The current captive flocks are largely derived from these two sources, particularly those bred at the Jersey Wildlife Federation Trust (King 1981). Of the

nine bird imported in 1966, more than 300 descendants had been bred as of 1980 (Grummt 1980), and a stud book has been organized to monitor the rate of inbreeding.

#### *Edwards' pheasant*

This species was not introduced to western aviculture until 1924, but breeding began the following year. Since then, wild birds have occasionally been added to the captive gene pool, and a moderately large number are now in captivity, primarily in the United States.

#### *Imperial pheasant*

The imperial pheasants upon which the description of the species was initially based were brought into captivity in 1924 by Jean Delacour, and bred the following year. All of the pure imperial pheasants now in captivity are the progeny of these two birds, although there are also a number of additional birds of hybrid origin (involving silver and Edwards' pheasants) that are phenotypically virtually identical to pure imperial pheasants (Carpentier, Yealland, van Bockstaele, and van den Bergh 1975).

#### *Swinhoe's pheasant*

This Taiwan endemic has been maintained and bred in captivity since 1866, and immediately began to breed freely. However, no wild birds have apparently been imported from Taiwan for more than 70 years (Delacour 1977), and thus the genetic variability of the captive population is probably relatively restricted. Nonetheless, it is still the most common captive species of all the forms listed in Table 22.

#### *Wattled pheasant*

Although this species was first brought into captivity in 1876, the first successful breeding did not occur until 1974 (King 1981). Since then several breedings have occurred in the United States and Mexico, and thus the numbers in captivity are slowly increasing. The large majority of the captive population is currently to be found in the United States.

#### *Mikado pheasant*

The mikado pheasant was first brought to England in 1912, and was raised successfully the following year. Additional wild stock was obtained during the 1920s by Jean Delacour, and since then the total captive stock has gradually increased. There have evidently been no recent additions of wild stock to the captive population.

#### *Palawan peacock pheasant*

The Palawan peacock pheasant was imported into the United States in 1929, and bred the following year. Since then there have been several importations of wild stock into North America and Europe, but the total captive population remains fairly low, with the largest numbers present in the U.S.A.

#### *Green peafowl*

Green peafowl have been maintained in captive collections for a very long time, and were present in the London Zoo as early as 1831 (Delacour 1977). Although it breeds well in captivity it is less hardy and more aggressive than the more common Indian peafowl, and the captive stocks are far smaller.

### **Rare Species**

#### *Blyth's tragopan*

This tragopan was maintained in European collections as early as 1870, but did not breed until 1884. After the Second World War the captive stocks gradually declined for lack of supplementation by wild stock. However, two pairs were imported into England in 1983 from Nagaland, which have subsequently been bred successfully.

#### *Sclater's monal*

The type specimen of this rare species was sent to the London Zoo in 1870, and there is survived for 20 months. There are no recent records of the birds being brought into captivity.

#### *Bar-tailed pheasant*

This species was initially maintained in India as early as 1888, but did not reach Europe until 1961, when a pair was imported into England. These birds bred the following year, and eventually were raised in fairly large numbers in Europe as well as North America. At present the largest numbers are in captivity in Great Britain, with somewhat smaller numbers present in North America.

#### *Crested argus*

This spectacular pheasant was first brought into Europe in 1924, and the birds were bred in France the following year. They proved very long-lived, and bred rather easily. By 1940 they were established in both Europe and North America, but all the captive stock died out shortly after the Second World War, and none is currently in captivity anywhere.





## II · SPECIES ACCOUNTS





# 1 · Keys to classification of the Phasianidae

## FAMILIES, SUBFAMILIES, AND TRIBES OF PHASIANIDAE

- A. Head and upper neck virtually naked in adults, including the crown.
  - B. The tail short (under 200 mm), of 14 rectrices, mostly hidden by the tail coverts: Numidinae (Guineafowl, 7 spp.).
  - BB. The tail long (over 200 mm) and rounded, 18 rectrices: Meleagridinae (Turkeys, 2 spp.).
- AA. Head and upper neck mostly or entirely feathered (if sparsely feathered, then the tail is greatly elongated and longer than the wing, and the crown feathered).
  - B. Tarsus more or less completely feathered; nostrils densely feathered: Tetraoninae (Grouse and ptarmigans, 16 spp.).<sup>1</sup>
  - BB. Tarsus unfeathered or at most only partially feathered, nostrils never completely hidden by feathers.
    - C. The lower mandible serrated toward the tip; males never with spurred tarsi: Odontophorinae (New World quails, 30 spp.).<sup>2</sup>
    - CC. The lower mandible completely smooth; males often with knobs or spurs on the tarsi.
      - D. Tail much shorter (maximum 200 mm) than wing, flat and usually rounded; males similar to females and usually not iridescent nor with extensive bare skin around eye: Perdicini (Old World quails, partridges, and francolins, 103 spp.).<sup>3</sup>
      - DD. Tail usually longer (minimum 150 mm) than wing, sometimes vaulted and often graduated; males often dissimilar to females and variably iridescent, nearly always with bare skin around the eye; Phasianini (Pheasants, junglefowl and peafowl, 49 spp.).

## GENERA OF PHASIANINI (AND CLOSELY RELATED PERDICINI)<sup>1</sup>

- A. Wing usually over 300 mm (min. 270 mm), tarsus usually over 100 mm, both sexes crested or tufted as adults.
- B. Tarsus unspurred, central rectrices greatly elongated.
  - C. Tarsus greyish, innermost primary not the longest: *Rheinartia* (1 sp.).

CC. Tarsus reddish, innermost primary the longest: *Argusianus* (1 sp.).

BB. Tarsus spurred and grey; tail-coverts long and iridescent.

C. Wing over 400 mm, 20 rectrices: *Pavo* (2 spp.).

CC. Wing under 350 mm, 14 rectrices: *Afropavo* (1 sp.).

AA. Wing usually under 240 mm (max. 330 mm), tarsus usually under 100 mm, crested or tufted condition of adults variable.

B. Tail long and graduated, the rectrices ocellated or partly iridescent, the fourth primary (from inside) the longest: *Polyplectron* (7 spp.).

BB. Tail variable but never ocellated to tipped with iridescence; fifth to seventh primary the longest.

C. Wings usually under 200 mm in females and 225 mm in males; tail of 10–14 rectrices, shorter than wing.

D. 10 rectrices, no spurs present in either sex: *Ophrysia* (in Perdicini).

DD. 14 rectrices, males or both sexes with up to four spurs.

E. Tail rounded, less than  $\frac{3}{4}$  length of wing, claw of hind toe rudimentary: *Caloperdix* (in Perdicini).

EE. Tail somewhat graduated, over  $\frac{3}{4}$  length of wing, claw normal.

F. Most body feathers lanceolate: *Ithaginus* (1 sp.).

FF. Body feathers not lanceolate: *Bambusicola* (in Perdicini).

CC. Wing usually longer (over 200 mm in females, 225 mm in males, usually at least 16 rectrices (rarely 14), tail often longer than wing.

D. Body feathers lanceolate in both sexes, and the face fully feathered: *Pucrasia* (1 sp.).

DD. Body feathers not lanceolate, males (and often females) variably naked around eye.

E. Body and upper wing feathers with white to buffy rounded spots, tail brown, rounded and nearly flat, no longer than wing; males with bare lappet and erectile 'horns': *Tragopan* (5 spp.).

EE. Body and upper wing feather not as described, tail often graduated and usually much longer than wing; males never with erectile horns.

F. Outermost primary longer than innermost; tail elongated and flat, with at least central pair of rectrices strongly barred.

G. Central rectrices of males very long (400–1600 mm) and not fringed laterally;

<sup>1</sup> See Johnsgard (1983b) for key to species.

<sup>2</sup> See Johnsgard (1971) for key to species (exclusive of *Odontophorus*).

<sup>3</sup> See Appendix 2 for annotated listing of species.

<sup>4</sup> Keys to species and subspecies of polytypic genera and species precede accounts of the genera in the text.

females with shorter and white-tipped rectrices: *Syrnaticus* (5 spp.).

GG. Central rectrices of males moderately long (400–500 mm) and fringed laterally; females with shorter barred rectrices that lack white tips: *Phasianus* (2 spp.).

FF. Outermost primary shorter than innermost, tail variable but if greatly elongated the central pair of rectrices enlarged and variably drooping.

G. Rectrices 20–24, the feathers large and broad, and the central pair drooping and disintegrated; no iridescent feathers present: *Crossoptilon* (3 spp.).

GG. Rectrices usually 14–18 (but 24–32 in one sp.), the central pair sometimes drooping but not disintegrated; males often iridescent.

H. Rectrices 14–18 (rarely greater), variably vaulted and compressed, bare facial area scarlet or blue, with lobes, wattles or lappets in males.

I. With smooth bare comb and throat lappets (reduced in females), ornamental and variably lanceolate neck feathers: *Gallus* (4 spp.).

II. With papillose blue or red face wattles, but no comb or lappet; neck feathers not lanceolate: *Lophura* (10 spp.).

HH. Rectrices 18; tail not strongly vaulted nor compressed; no combs or lappets in males.

I. Tail squarish and chestnut or iridescent and shorter than wings; both sexes with bright blue skin around eyes; males blackish below and extensively iridescent above: *Lophophorus* (3 spp.).

II. Tail highly graduated, not iridescent or chestnut, and much longer than wing; bare area around eyes never bright blue.

J. With red facial skin, a greyish throat and a straight brownish occipital crest: *Catreus* (1 sp.).

JJ. Never with red facial skin or a greyish throat; a decumbent colourful crest present in males: *Chrysolophus* (2 spp.).

## 2 · Genus *Ithaginis* Wagler 1832

The blood pheasant is a small partridge-like montane species with a plumage that is very soft, and with lanceolate feathers in males. The sexes are moderately dimorphic. A soft, short crest is present in both sexes, and males have a crimson feather colouration on the chin and the base of the tail. A small, bare orbital skin area is present. The wing is short and rounded, with the tenth (outermost) primary shorter than or nearly equal to the first. The tail is rounded, and of 14 rectrices. The tail moult is perdicine, proceeding from the central feathers outwardly (centrifugal). The bill is short, stout, and curved, and similar to that of some partridges and grouse. The tarsus is long and stout, with several spurs in males and knobs in females. A single species is recognized here.

### KEY TO SUBSPECIES OF ITHAGINIS CRUENTUS MALES (in part after Delacour 1977)

- A. Throat red or tinged with red.
  - B. Ear-coverts wholly black.
    - C. Supercilium black: Kuser's blood pheasant (*kuseri*).
    - CC. Supercilium red and black: Mrs Vernay's blood pheasant (*marionae*).
  - BB. Ear-coverts streaked with black and white.
    - C. Supercilium red and black.
      - D. Crest feathers disintegrated: Tibetan blood pheasant (*tibetanus*).
      - DD. Crest feathers normal: Greenway's blood pheasant (*holoptilus*).<sup>1</sup>
    - CC. Supercilium black.
      - D. Median wing-coverts grey, with a wide, pale green central streak.
        - E. Crimson on crown: Himalayan blood pheasant (*cruentus*).
        - EE. No crimson on crown: Sikkim blood pheasant.<sup>2</sup>
      - DD. Median wing-coverts entirely green.
        - E. Darker, crest shorter: Rock's blood pheasant (*rocki*).
        - EE. Lighter, crest longer: Clarke's blood pheasant (*clarkei*).
- AA. Throat grey.
  - B. Median wing-coverts wholly green: Geoffroy's blood pheasant (*geoffroyi*).

<sup>1</sup> Doubtfully distinct from *rocki* (Cheng Tso-hsin, Tan Yao-kuang, Lu Tai-chun, Bao Gui-jun, and Li Fu-lai. 1978, p. 113)

<sup>2</sup> Doubtfully distinct from *cruentus* (*Ibis* 1915, pp. 124–5).

- BB. Median wing-coverts not wholly green.
  - C. Median wing-coverts brown and green.
    - D. Median wing-coverts marked brown and green: Bianchi's blood pheasant (*michaelis*).
    - DD. Median wing-coverts brown, washed with green: Beick's blood pheasant (*beicki*).
  - CC. Median wing-coverts entirely brown.
    - D. White shaft-lines on mantle narrow: David's blood pheasant (*sinensis*).
    - DD. White shaft-lines on mantle wider.
      - E. Lighter, more reddish on cheeks, chin and wings, tail pinker: Mrs Seye's blood pheasant (*annae*).<sup>3</sup>
      - EE. Darker and less reddish on cheeks, chin and wings, tail more crimson: Berezowski's blood pheasant (*berezowskii*).

### BLOOD PHEASANT

*Ithaginis cruentus* (Hardwicke) 1822

Other vernacular names: None in general English use; ithagine ensanglantee (French); Blutfasan (German), semo (Tibet), chilime (Nepal).

#### *Distribution of species*

Himalayas from Nepal eastward through Tibet and Sikang to the ranges of the Nan Shan in Tsinghai and Kansu, and through northern Szechwan to southern Shensi and neighbouring Honan, south from Sikang to north-west Yunnan and neighbouring north-east Burma. Sedentary, breeding at altitudes varying from about 10 000 to 15 000 ft, but moving altitudinally, down to about 7000 ft in the winter in some regions. Occurs in upper reaches of the coniferous forest, and in rhododendrons or other scrub above it, to the edge of the snow fields, receding or advancing with the snows on which it is often seen (Vaurie 1965). See Map 1.

#### *Distribution of subspecies (after Vaurie 1965 and Wayre 1969)*

*Ithaginis cruentus cruentus* (Hardwicke): Himalayan blood pheasant (includes *affinis* Beebe). Resident from northern Nepal eastward to north-west Bhutan, a population that has at times been recognized as a separate race (*affinis*). Ranges from subtropical pine to snowline, between 6000 and 14 000 ft.

<sup>3</sup> Doubtfully distinct from *berezowskii* (Cheng *et al.* 1978, p. 111).





**Map 1.** Distribution of Berezowski's (B), Beick's (Be), Bianchi's (Bi), Clarke's (C), David's (D), Geoffroy's (G), Himalayan (H), Kuser's (K), Rock's (R), Tibetan (T), and Mrs. Vernay's (V) races of blood pheasant.

*Ithaginis cruentus tibetanus* Stuart Baker: Tibetan blood pheasant. Bhutan east of nominate *cruentus* and southern Tibet, where it intergrades with *kuseri* between long. 92 and 93°, in rhododendron scrub.

*Ithaginis cruentus kuseri* Beebe: Kuser's blood pheasant. Tibet and Himalayas, east of *tibetanus*, eastward to the upper Salween and Mekong, south to about lat. 28° N. Intergrades with *marionae* and *rocki*. From 8000 to 14 000 ft, in scrub and alpine forest.

*Ithaginis cruentus marionae* Mayr: Mrs Vernay's blood pheasant. Mountains of north-east Burma on the border of Yunnan east to the Shweli-Salween Divide. Intergrades with *kuseri*.

*Ithaginis cruentus rocki* Riley: Rock's blood pheasant. North-west Yunnan at about lat. 27° N in the region between the Salween and Yangtze rivers. Possibly an intergrade form between *kuseri* and *clarkei*. Includes *I. c. holoptilus* Greenway (1933).

*Ithaginis cruentus clarkei* Rothschild: Clarke's blood pheasant. North-west Yunnan in the Likang range.

*Ithaginis cruentus geoffroyi* Verreaux: Geoffroy's blood pheasant. Northern, central and eastern Sik-

ang (currently part of western Szechwan and south-east Xizang).

*Ithaginis cruentus berezowskii* Bianchi: Berezowski's blood pheasant. Mountains of western and north-west Szechwan north to the region of Sungpan and southern Kansu. Includes *annae* Mayr and Birkhead (1937).

*Ithaginis cruentus beicki* Mayr and Birkhead: Beick's blood pheasant. North-east Tsinghai in the region of the middle River Tatung to neighbouring central Kansu, where it intergrades with *michaelis*.

*Ithaginis cruentus michaelis* Bianchi: Bianchi's blood pheasant. Northern and central Nan Shan Range (Tsinghai), grading southward into *beicki*.

*Ithaginis cruentus sinensis* David: David's blood pheasant. Mountains of southern Shensi (Tsinling range) east to those of south-west Honan.

### Measurements

Ali and Ripley (1978) report the weights of males of *cruentus* to range from 1 lb 1 oz to 1 lb 4 oz (c. 482–568 g). Cheng *et al.* (1978) reported the weights of five males of *berezowskii* as 520–600 g, and of three females as 410–620 g. A single male of *michae-*

Measurements of wing and tail length (after various sources, including personal observations)

	Males		Females	
	Wing (mm)	Tail (mm)	Wing (mm)	Tail (mm)
<i>cruentus</i>	194–228	164–178	179–197	140–154
<i>tibetanus</i>	197	177.5	190–196	—
<i>berezowskii</i>	188–204	162–178	178–184	138–159
<i>marionae</i>	190–200	—	197	130
<i>rocki</i>	196–199	—	180–186	135
<i>clarkei</i>	202–214	162–176	185–208	141
<i>geoffroyi</i>	208–223	165–190	205–210	150–162
<i>beicki</i>	204–225	—	192–211	—
<i>kuseri</i>	197–210	147–171	184–190	—
<i>sinensis</i>	205–213	165–180	190–199	132–150
All races	188–228	162–190	178–211	130–162

*lis* weighed 655 g. The eggs average  $48 \times 33$  mm, and the estimated fresh weight is 28.8 g.

#### Description (after Baker 1928)

##### *Male (of cruentus)*

Lores, forehead, supercilium and a broad line under the eye black; the black changing to buff on the crown and to grey on the longest crest feathers, which have central white streaks; whole upper surface grey, with central white streaks, narrowest on the mantle, broadest on the rump and upper tail-coverts, where the streaks are edged with black; chin and throat crimson, the feathers with black bases and tiny yellow-white specks at the tips; ear-coverts, sides of head and neck black and white or yellowish-white, foreneck yellowish-green with black bars and edges to each feather, the black varying much in extent; lesser and median wing-coverts like the back, more broadly streaked; primaries and outer secondaries brown; white-shafted and sometimes mottled on the outer webs; greater coverts and inner secondaries marked with green and with broad yellowish shaft-stripes edged with black; longest tail-coverts edged with crimson; tail feathers pale brown, almost white and edged and mottled with brown on the terminal portions; central tail feathers edged with crimson throughout their length, lateral feathers at their bases only; upper breast yellowish-green, more or less splashed with crimson; lower breast and flanks the same, with darker greener borders; abdomen dull ashy buff, more or less covered by the lanceolate green feathers of the flanks and breast; under tail-coverts crimson with yellow specks at the tips. Iris red-brown or hazel; bill black; cere and gape coral-red to crimson; orbital skin scar-

let to orange-vermilion; legs and spurs crimson; claws dusky.

##### *Female*

Forehead, sides of the head, chin and throat rufescent-ochre; anterior crest and nape slaty grey, shading off into the surrounding colours; remainder of upperparts, wings and tail rufescent earth-brown, finely vermiculated all over with darker brown, more boldly on the tail and the primaries than elsewhere; outer tail feathers more rufous and more boldly marked than the inner; lower plumage bright rufous-brown, immaculate on the foreneck and breast, finely vermiculated elsewhere. Cere and orbital skin carmine-yellow, pale salmon in winter; legs bright red, paler in winter (Delacour 1977).

##### *Young males*

Like the adult, but less brilliantly coloured and the bill orange-red; the orbital skin and cere are fleshy grey. By three weeks the male is distinctly greyer than the female, and by six weeks the male has a red throat.

#### Identification

##### *In the field* (18 in.)

This rather 'chunky' species resembles a large partridge, but no partridge or other species of pheasant has crimson on the forehead, tail coverts and tail, or pale green sides, underparts and on the tail. Females are similar to males, but are uniformly reddish brown, with a greyish to dull-tawny head and throat that is sometimes tinged with crimson. Both sexes have red feet as well as a red area of bare skin around the eye. Both sexes are also quite vocal. The calls include a rallying call of scattered coveys, which is a



long, high-pitched squeal resembling that of a kite. Short monosyllabic alarm notes are also used. Found in upper montane forest and subalpine scrub.

#### *In the hand*

The distinctive crimson tinge on the face and tail of the male will immediately serve for identification, but females are less easily identified. The rather large area of bare red skin around the eye and the red legs, together with a relatively small size (wing 178–211 mm) and a faintly vermiculated rufous to brownish plumage without strong patterning, should serve to separate females from all other pheasants and the few species of large partridges with which they might be confused.

### Geographic variation

Variation among the males of this species is very great, and tends to be clinal. Two general groups are recognized, including a more southern and western series of populations (the nominate *cruentus* group), and a more northerly and easterly group (the *sinensis* complex, including *michaelis*, *beichi*, *berezowskii*, *annae*, and *sinensis*). In the nominate group the greater upper wing-coverts are green or are at least well tinged with green, while in the *sinensis* group these feathers are reddish brown. The *sinensis* group males also have distinct 'ear-tufts' and lack crimson pigments on the head and breast. However, these differences are not entirely clear-cut, as some individuals of the *sinensis* group may show crimson feathers on the forehead and chin, and some races (*beicki* and *michaelis*) of the *sinensis* group have wing-coverts that are somewhat tinged with green. The crimson pigments are increasingly disseminated on the head and breast from west to east in the nominate group (or from *cruentus* to *kuseri*, but decrease in north-west Yunnan (from *rocki* to *clarkei*), and disappear farther east in *geoffroyi*. Furthermore, the ear-tufts may be seen in reduced form as far west as *kuseri*, and there is a clinal decrease in general colour saturation from north to south among the races of the *sinensis* group. Females of the two groups are much more uniform, but in the *sinensis* group they also exhibit ear-tufts, and are generally more greyish and less ochraceous on the face and throat than are those of the nominate group (Vaurie 1965).

### Ecology

#### *Habitats and population density*

Beebe (1918–1922) described the habitats of *geoffroyi* as ranging from 12–15 000 ft, and including

firs, larches, and oaks, plus the higher tree-like and shrub-like zones of rhododendrons, and finally the alpine meadow and grasses at elevations of about 16 000 ft. He suggested that the seasonal movements may involve migrations of several thousand feet of altitude annually, although on more sheltered ranges the birds might remain the entire year with much less seasonal movement. Of *kuseri* he stated that the birds are usually found in bamboo jungle close to snowline, but in early mornings and late evenings the birds come out into the open. Where there was no snow the birds were very conspicuous in this habitat, which probably accounts for the restriction of their activity in such open areas to periods near sunrise and sunset.

According to Beebe, the summer period is spent hardly lower than the upper zone of small pines, and the birds often range upward to the tundra-like zone of alpine meadowland. Soon after the autumn establishment of coveys, the birds begin to be forced downward by snowfall. They evidently show no preference for either northern or southern exposures, and during this period spend much of their life in the open, but always close to low, dense undergrowth. In the eastern Himalayas rhododendron forests and silver firs occur in this zone, while in parts of Nepal the birds apparently prefer clumps of mountain bamboo. Where bamboo is abundant the birds seem to favour it for shelter, but prefer to roost in trees such as rhododendrons or firs. By winter, they are found among the open coniferous forests of fir and juniper nearer the lower elevations.

There is little direct information on population densities, but most accounts suggest that the birds are sometimes fairly common, occurring in flocks of from about 10–30 birds, and there is an early account of an English sportsman who shot 36 birds on a single ridge during one day. Lelliott and Yonzon (1981) reported that in Nepal they observed a density of between 6 and 9 pairs in a study area of 1.2 km<sup>2</sup>.

#### *Competitors and predators*

Beebe (1918–1922) said that little information was available to him on competitors and predators. He judged that neither Himalayan monals nor snowcocks posed significant competitive threats. Of predators, he judged the grey fox (*Vulpes ferilata*!) to be probably the most serious threat, and noted that it was one of the commonest carnivores of the upper rhododendron zone. He also reported that beech martens (*Martes flavigula*!) were sometimes in the same area, and imagined that both dholes (*Cuon alpinus*) and Himalayan leopards (*Panthera pardus*) probably take some blood pheasants. The major large raptors of their area are the golden eagle (*Aquila chrysaetos*) and Bonelli's eagle (*Hieraetus*



*fasciatus*). Beebe commented that the females more nearly match their rocky background than do males, and that when squatting the males do not exhibit any of the crimson colouring of their underparts.

## General biology

### *Foods and foraging behaviour*

Foods evidently vary greatly by season in blood pheasants. During the winter the birds are believed to feed mostly on shoots of firs and junipers, as well as on berries, mosses and bamboo leaves. Beebe (1918–1922) noted that birds shot during periods of heavy snow in fir forests were almost inedible because of their diet of fir and juniper sprouts. Earlier in the fall they apparently live on small fruits, leaves, seeds and moss spore cases, as well as on bamboo shoots, berries and rose pips. In mid-April he observed a flock foraging after a heavy snowfall on lily seed cases, which upon inspection proved not only to have seeds present but also various insects.

There is apparently no specific foraging period, according to Beebe. The birds sometimes may be found feeding at high noon, scratching for berries and insects among moss and coarse grasses. Unlike the Himalayan monals of the same area, the birds are strong scratchers, but do not have favourite scratching sites.

In captivity, it has been found that the birds do a great deal of grazing, and in Major Iain Grahame's aviaries they kept a grassy area plucked so short that it resembled a lawn (Grahame 1971, 1976). They also ate lucerne (alfalfa) pellets, turkey pellets, kibbled maize, and a mixture of such things as boiled eggs, diced apples, raisins, carrots, mealworms, and softbill food. Other aviculturists have noted that the birds favour chopped lettuce, onions, and potatoes (Roles 1981).

### *Movements or migrations*

The seasonal altitudinal movements typical of blood pheasants were mentioned earlier. These movements are evidently fairly leisurely ones, done on foot. Their movements are rather slow and fowl-like, but with the tail held low and partridge-like. When alarmed, the birds arise in a quail-like covey, but their flights are brief and direct. On alighting they prefer to run uphill, into the nearest cover, which is usually scrub rhododendrons. If trees are nearby, and a dog flushes them, they may simply fly up to the lower branches. With lesser degrees of alarm they may flee on foot, running with their necks outstretched and their heads and tails held rather high (Beebe 1918–1922).

### *Daily activities and sociality*

Throughout most of the day the birds forage actively, typically in coveys or families, and the birds also roost together through the night-time hours. At least at times the same roosting site will be used on consecutive nights, and roosting may be done in trees, amid thickets, or on the ground. Occasionally when roosting on the ground the birds will cluster in the shelter of a crag or boulder, and orient themselves outward from the centre, in typical quail-like manner (Beebe 1918–1922). There is less evidence that the birds regularly burrow into snow, for although this was reported as typical in early literature, Beebe (1918–1922) suggested that the cold night fogs of the Himalayas often turn the snow crust to ice, and thus make such behaviour extremely risky for birds. He believed that snow tunnelling is thus either extremely rare or perhaps even of accidental occurrence owing to the possible snowing-in of a covey. Grahame (1971) likewise doubts that the birds ever tunnel, for their habitats contain innumerable caves and overhanging boulders under which they might easily roost.

It is not yet known when the coveys dissolve prior to the breeding season, but this is likely to occur shortly prior to the nesting season; the coveys are certainly re-established in early autumn by the amalgamation of family units. Beebe (1918–1922) states that this autumn period of covey formation occurs about October, and a flock consisting of several families is likely to consist of from as few as 15 to as many as 40 birds. These groups remain together throughout the winter, roosting and feeding closely together. The sex ratio of such flocks is apparently nearly even, or perhaps has a slight excess of males.

## Social behaviour

### *Mating system and territoriality*

Nearly all writers have commented on the monogamous nature of this species. Beebe (1918–1922) reports that pairs of birds and their young remain together through the winter, and thus presumably an essentially permanent pair bond is maintained. This conclusion was partially based on Beebe's observations that the flocks he saw consisted of approximately equal numbers of males and females. Although there seems to be no good evidence to support this view, there is also little reason to doubt it, given the low degree of sexual dimorphism and the seemingly rare and simple display tendencies of the birds. However, it has been suggested too that perhaps the birds may also be occasionally polyandrous or polygynous (Ludlow and Kinnear 1944). There is

likewise no good information on territoriality, although in captivity it has been noted that males tend to be quarrelsome with one another. Graham (1971, 1976) judged that the species shows 'loose monogamous pair-formations within coveys'. In captivity, he found that when two pairs were placed in a group of three adjacent and connected aviaries (33×7 ft) each of the two pairs occupied one of the end cages, and the middle cage became a 'no man's land' into which occasional sallies were made by the males or sometimes both members of a pair. This resulted in much chasing, either by male after male, or male after female.

#### *Voice and display*

The earliest notes on vocalizations come from Beebe (1918–1922). He observed that when threatened the flock members utter a series of sudden sharp notes, *seep! seep! seep!* After the scattered flock members have begun to reassemble, they utter a covey call, *see-e-e-elpe!*, which is simply a more drawn out alarm note, but with a snapping off at the end. He also once heard a male within the flock uttering a repeated *silpe* note that somewhat approached a cackling call. Others have described the alarm note as a harsh *ship, ship*, and the presence of another note sounding something like the squeal of a kite (Baker 1935). Beebe (1918–1922) described the call of *geoffroyi* as a single long and drawn-out wheezy whistle, followed by several sharper notes, and another call as loud and long-continued squealing sounds. Both of these were based on second-hand observations.

Recently, Lelliott (1981*b*) has observed the behaviour of this species in some detail, and has provided a good deal of new information on its vocalizations and other behaviour. He recognized a total of five types of call of fairly definite meaning. The first of these is the '*sree*' call, which is a high-pitched squeal uttered an average of four to nine times per minute while the birds were foraging. The second is a high-pitched trill, lasting nearly a second, and seemingly associated with mild alarm. The trill calls were uttered by both sexes and were used to maintain contact between pairs. A loud, piercing, muted squeal, *sree cheeu, cheeu, cheeu . . .*, with a varying number (2–6) of *cheeu* notes, was uttered by both sexes and evidently served to bring scattered individuals of a covey back together following separation. There is some evidence that birds of a covey are able to recognize the call notes of other birds of that covey, and approach such calls, while the playback of calls of birds from one covey to those of another covey tended to repel them. This is the call that Beebe (1918–1922) referred to as a covey call, and has been described by others as resembling the

squeal of a kite. A fourth call described by Lelliott was described as a high-pitched, strident *chic* note of short duration, and repeated at intervals of about one or two seconds. This call was observed to be uttered by both sexes, and at least in the case of males was usually associated with alarm behaviour. The last call, a buzzing note of about a second in duration, was heard only from males, and Lelliott suspected that it may have been produced by the bird's feathers, since it was apparently associated with tail-fanning during display.

Lelliott observed these birds primarily during the breeding season, during which 71 per cent of the birds observed were in pairs or multiples of pairs, 20 per cent were of single males, and there was one observation each of a group of four males and a single female. On this basis he judged the birds to be monogamous, and he observed no courtship display. He did observe one copulation, however, which was preceded by the female standing on a raised rock and uttering the 'trill' call prior to squatting down. The male then approached and the pair copulated for some 10–15 s, while both birds called softly. Following treading the birds continued to feed quietly.

Almost nothing has been written on display in the blood pheasant, presumably reflecting its relative rarity and inconspicuous nature. Beebe (1918–1922) stated that during courtship the male 'spreads its tail and wings, drooping the latter, raises the crest, swells out the breast feathers, and struts before the female, turning round and round.' In the courtship period the males are said to fight fiercely with one another. Whether the wing-drooping and turning round the female he described corresponds to the waltzing display, as seems likely, is not certain. It would also be of interest to learn if tidbitting behaviour occurs in this species. Graham (1976) stated that the only sound he heard from his captive blood pheasants during display was a *purrrh*, made by suddenly fanning the tail feathers. He said that their display resembles that of the koklass, although it has more 'urgency' of movement and is less noisy than for that species. In general the display consisted mostly of crest-raising and a good deal of chasing, but no evident vocalizations.

### **Reproductive biology**

#### *Breeding season and nesting*

The nesting season of the blood pheasant is known only in a general way. Reportedly *cruentus* breeds in April and May, and a nest containing three fresh eggs of *kuseri* were found in the beginning of May (Baker 1935). Graham (1976) reported that in Nepal the coveys have apparently broken up by late April,



but laying has not yet begun. Laying apparently there coincides with the blooming of the rhododendrons (*R. campanulatum*). A nest was later found on 13 May with seven eggs. One nest of *geoffroyi* was found at 13 500 ft under brushwood in a forest and contained seven eggs. These were of a narrow and elongated oval shape, and were pale reddish buff with irregular blotches of several shades, the darkest being deep reddish brown (Beebe 1918–1922).

Of *cruentus*, the nest is said to be constructed of grass and leaves on the ground among bushes and grass. Two nests found in Sikkim were at about 12 000 ft, and the eggs were located in a hollow scratched in a pile of loose fallen leaves at the foot of bushes in a pine forest. A nest of *kuseri* with two eggs was located at about 12 000 ft under a clump of bamboos, the surrounding area then still being largely under snow. In Bhutan a nest with four eggs was located on 30 May, land was situated on a bank under an overhanging shrub. Similarly, a nest of *kuseri* was located on 29 May, at 12 000 ft, near Lagong, Tibet. It contained six incubated eggs, and was on a bank under a juniper (Ludlow, 1944).

#### *Incubation and brooding*

There are no good accounts of incubation in the wild, but Grahame (1971, 1976) has provided a good deal of avicultural information on the species. Of two pairs that Grahame had in connected aviaries, the females laid a total of 15 eggs between 20 April and 16 May, with the females sometimes laying in one another's nest. The incubation period was found to range from 26 to 29 days, but averaged 27 days. He obtained fertile eggs from one year-old female mated to an older male, and from a single male mated to two females. Females seemingly preferred to nest in baskets located a metre or two above the ground. Their eggs were incubated artificially.

#### *Growth and development of young*

The chicks tended to be very wild during the first few days, and often would hide in corners (Grahame 1971, 1976). By the time they were 24 hrs old they were already grazing, and made goose-like plucking movements. When they were only five days old the

males could be told from females by the first signs of grey on their shoulders, and full adult plumage was attained when the birds were five months old. By their first winter they differed from older birds only in having shorter spurs. There was much individual variation in the amount of red present on the breast.

Of 62 eggs laid, Grahame was able to hatch 29 young and rear 12 of them. The birds are apparently very susceptible to diseases such as aspergillosis and tuberculosis, and to infections of the liver, kidneys, and caecum.

#### **Evolutionary history and relationships**

There are still no good bases for classifying the blood pheasants in either the *Perdicini* or the *Phasianini*, although there is certainly little reason for believing that they are closer to the pheasants than to the Old World partridges. Apart from the monogamous mating system, the covey-like social organization is certainly partridge-like, and the majority of the plumage characteristics are also partridge-like. Delacour (1977) suggested that the lanceolate feathers, crest, and short beak all suggest a possible relationship to *Pucrasia*. Grahame (1971, 1976) also mentioned some similarities in the sexual displays of these two forms, both of which also seem to be highly herbivorous.

#### **Status and conservation outlook**

The remote habitat of the blood pheasant is likely to keep it out of direct conflict with human activities for the foreseeable future, and it is too small and too inconspicuous to be overhunted for either sport or food. Nevertheless it is perhaps the tamest of all the pheasants, and thus is subject to local extirpation by natives if hunting is not controlled. Gaston (1981a) judged that the species is fairly common throughout its range in the central and eastern Himalayas, and is still numerous in some places. He considered its habitat to probably be in no significant danger of reduction, and its status there as safe. The status and abundance of the Chinese populations is not as well known.



### 3 · Genus *Tragopan* Cuvier 1829

The tragopans or horned pheasants are medium-sized montane pheasants in which the sexes are highly dimorphic, the males tending toward crimson on the head and sometimes elsewhere, and with extensive white to buffy dorsal spotting. The wings are rounded, with the tenth primary the shortest, and the fifth and sixth the longest. The tail comprises 18 feathers, is rounded, and usually shorter than the wing. The tail moult is perdicine (centrifugal). The bill is short and stout, with the forehead feathers almost reaching the nostril. The tarsus is very stout, about as long as the middle toe and claw, and in males has a short spur. Males also have a short occipital crest, two erectile and brightly coloured fleshy horns that are erected during courtship, and a brilliantly coloured gular lappet or bib that can be expanded and exposed during display. The sides of the head and throat are naked or only thinly feathered and brightly coloured. Five species are recognized.

#### KEY TO SPECIES (AND SUBSPECIES OF MALES) OF *TRAGOPAN*

- A. Head red and black, with a colourful face and lappet (males).
  - B. Underparts spotted; with red to bluish facial skin.
    - C. Spots on underparts large, pearl grey, and edged with brown; face bluish: Temminck's tragopan.
    - CC. Spots on underparts small and white, edged with black.
      - D. Breast and upperparts mostly reddish brown, face dark bluish: satyr tragopan.
      - DD. Breast and upperparts mostly grey to blackish, face reddish-orange: western tragopan.
  - BB. Underparts not spotted; with yellowish to orange facial skin.
    - C. Breast and underparts buffy; upperparts spotted with buffy: Cabot's tragopan.<sup>1</sup>
    - CC. Breast and underparts reddish to greyish; upperparts spotted with white; Blyth's tragopan.
      - D. Paler, red of breast forming a broad band: eastern Blyth's tragopan (*blythi*).
      - DD. Darker, red of breast forming a narrow band: western Blyth's tragopan (*molesworthi*).
- AA. Head brownish or greyish; no bare lappet (females).
  - B. Dorsal plumage streaked with white; orbital skin reddish to orange.

- C. Grey dominant in ventral plumage; small round white spots dorsally: western tragopan.
- CC. White or buff dominant in ventral plumage; whitish triangular markings dorsally: Cabot's tragopan.
- BB. Dorsal plumage not streaked with white; orbital skin yellowish to bluish.
  - C. Bend of wing not orange-rufous; bluish orbital skin: Temminck's tragopan.
  - CC. Bend of wing usually a rich orange-rufous; if not, then with yellowish orbital skin.
    - D. General plumage tone olive, with coarse markings; black ocelli dominant dorsally; yellowish orbital skin: Blyth's tragopan.
    - DD. General plumage tone creamy buff, with fine markings; black ocelli not dominant in dorsal plumage; bluish orbital skin: satyr tragopan.

#### WESTERN TRAGOPAN<sup>2</sup>

*Tragopan melanocephalus* (J. E. Gray) 1829

Other vernacular names: western horned pheasant; black-headed tragopan; tragopan de Hastings (French); West-Satyrhuhn, Jewar (German); singmoonal (W. Himalayas).

#### *Distribution of species*

Western Himalayas, between about 8000 and 12 000 ft, from Hazara eastward to Garhwal, and has been reported from Ladakh. The Ganges seems to constitute the eastern limit of the range. Moves altitudinally, wandering occasionally down to 4000 ft in winter. Occurs in dense coniferous or mixed mountain forests to rhododendrons or birch scrub at the upper edge of the forest (Vaurie 1965). See map 2.

#### *Distribution of subspecies*

None recognised.

#### Measurements

Delacour (1977) reported that males have a wing of 255–290 mm and a tail of 220–250 mm, while females have a wing of 225–250 mm, and a tail of 190–200 mm. Males weigh 4 to 4 $\frac{3}{4}$  lb (c. 1800–2150 g) and females 2 $\frac{3}{4}$  to 3 lb (c. 1250–1400 g; Ali and Ripley 1978). The eggs average about 63 × 42 mm, and have an estimated fresh weight of 61.3 g.

<sup>1</sup> See text for subspecies determination.

<sup>2</sup> Endangered species (King 1981).



**Map 2.** Distribution of tragopans, including Blyth's (B), Cabot's (C), eastern Blyth's (E), satyr (S), Temminck's (T), western Blyth's (W), and western Blyth's (We), and western Cabot's (WC). Dotted lines show presumed original ranges of western and western Blyth's; cross-hatching indicates presumptive maximum range of eastern Blyth's. Blackened areas or locality dots indicate known current ranges of these forms, and upper inset maps show detailed known current distributions of the western tragopan (upper left) and known Nagaland range of the eastern Blyth's (upper right).

## Description

### Male

Crown black, with decumbent red-tipped occipital crest. Face naked bright red. Upperparts including wing-coverts and tertiaries finely vermiculated buffy grey and black, and with round black-bordered white spots or ocelli. Neck red. Tail mottled buff and black, with irregular black bars and tips. Naked throat deep blue; foreneck and upper breast bright light red. Rest of underparts black, ocellated with white and irregularly smeared with red; flanks and abdomen mottled with brown and black. Iris brown.

Bill black, tip horny. Bare skin of face bright red with lines of small blue spots below eyes. Throat skin deep blue; cheeks blue-green; lappet purplish blue down centre, pink on margins, with pale blue indentations. Fleishy horns blue. Legs pink to whitish grey, varying with season (Delacour 1977).

### Female

General effect grey instead of rufous-brown as in *satyra*. Above brownish grey; head and neck tinged with rufous, rest of upperparts irregularly streaked and spotted with black and white. Underparts



vermiculated grey and dark brown, spotted with fulvous on throat, and broadly streaked and splotched with white on the paler and greyer abdomen and flanks.

#### *Immature male*

Like female, but the marks below more rounded, less spatulate in shape. At an older stage also like female but larger, relatively taller, and with a variable amount of black on the head and of red on the neck, and a number of white spots, surrounded with black, on the upper back and underparts (Delacour 1977).

#### *Juvenile*

Like that of *satyra*, but greyer.

### Identification

#### *In the field* (25–27 in.)

This species resembles a large but stout pheasant, and is usually seen singly, in pairs, or small coveys, in fairly dense montane vegetation. The white circular spotting on the greyish upperparts, especially the lower back and upper tail-coverts is distinctive, but the spotting is less regular in females than in males. Both sexes have reddish faces, and the legs are usually pinkish. During the breeding season the male can be identified by its distinctive call, uttered most often at dusk and daybreak at intervals of about five or ten minutes. It is a far-carrying *waa* note, resembling a goose calling or the bleating of a small goat. The only other tragopan possibly occurring within this species' range is the satyr.

#### *In the hand*

Males may be easily distinguished by their predominantly grey upperparts and reddish facial skin. Females are more brownish grey, both above and below, and their distinctly greyish cast with black vermiculations with separate them from all other species of the genus. The extensive white spotting helps to separate female tragopans from those of other pheasants, and the elongated white central spot on each feather is bordered with black.

### Ecology

#### *Habitats and population densities*

Islam (1983) has summarized the general habitat characteristics of the western tragopan as consisting of a summer range in forests of spruce (*Picea smythiana*), deodar cedar (*Cedrus deodara*) and brown oak (*Quercus semicarpifolia*) at the upper edge of the tree-line, from 2500–3600 m elevation. During winter they are found in mid-altitudinal dense conifer-

ous or mixed mountain forests with a northern aspect, and between 2000 and 2800 m. An undergrowth cover of rue (*Ruta*) and ringal bamboo (*Arundinaria*) provides dense cover in both summer and winter habitats in eastern parts of its range.

In Pakistan the birds occur in steep forested slopes in a transition zone between moist and dry temperate climatic zones, in dense forests. Islam observed them in predominately coniferous, predominately deciduous, and mixed coniferous–deciduous forests, with the coniferous species consisting of fir (*Abies pindrow*), blue pine (*Pinus wallichiana*), spruce, and yew (*Taxus wallichiana*), the deciduous species being brown oak, cherry (*Prunus padus*), walnut (*Juglans regia*), horse chestnut (*Aesculus indica*), maple (*Acer caesium*), and birch (*Betula utilis*). All forests where tragopans were observed were characterized by having thick undergrowths of *Viburnum nervosum*, with *Skimmia laureola* and bracken fern (*Pteridium* spp.) in some areas. Rue and ringal bamboo do not occur in Pakistan (Islam 1983).

In Himachal Pradesh the birds primarily occur between 2500 and 3000 m, but occasionally occur below 2000 m, presumably in winter. However, they have been observed as high as 2900 m in November and January, suggesting that at least some of the birds are fairly sedentary (Gaston *et al.* 1981). There the species shows a preference for higher altitude coniferous forests, but Gaston *et al.* occasionally observed them in mixed deciduous forest and in higher altitude oak forests.

The species is now so rare that population densities are very difficult or impossible to estimate, but Gaston *et al.* (1981) noted that in 400 party-hours spent in the proposed Manali National Park only four sightings were obtained in the three main river valleys (Solang, Manalsu, and Hamta). They judged that the entire upper Beas Valley probably supports no more than about 1000 birds. This area consists of approximately some 15 000 km<sup>2</sup>. Mirza (1981a) judged that in the Neelum Valley of Pakistan there may be 1–2 pairs per square mile (2.6 km<sup>2</sup>) of habitat. Islam (1983) observed 29 birds in three areas of Pakistan, giving a density of 1.3 birds per km<sup>2</sup>. In 1977, in the Salkhala reserve, 12 males were heard and six birds were seen in a 31 km<sup>2</sup> area, and nine were reported in an area of 26 km<sup>2</sup> in Kuttan reserve, in the Neelum Valley (Mirza 1976). These would all suggest densities of from 1.3 to considerably less than one bird per km<sup>2</sup> of habitat.

#### *Competitors and predators*

In Himachal Pradesh, this species occurs in company with at least four other species of pheasants, but only the koklass and Himalayan monal are relatively common in the ecological zones favoured by



the western tragopan. Neither one is likely to be a significant competitor to it. At the eastern edge of its range the western tragopan probably encounters the satyr tragopan, and the two species seem to be ecological replacement forms, suggesting that competition between them does indeed exist. The Jumna valley seems to represent the approximate point of geographic contact between them (Gaston 1981a).

Islam (1983) did not mention any predators of significance to the status of the western tragopan in Pakistan. Gaston *et al.* (1981) list a substantial number of predatory mammals occurring in Himachal Pradesh (three canids, two bears, a weasel (*Mustela sibirica*), a marten (*Martes flavigula*), a civet (*Paguma larvata*), a cat (*Felis chaus*) and the leopard (*Panthera pardus*), most of which might represent varying levels of threat to tragopans, particularly the felids and mustelids. However, they found no direct evidence of tragopan predation for any of these species.

### General biology

#### *Food and foraging behaviour*

Beebe (1918–1922) found western tragopans to be foraging on newly sprouted leaves, and based on the accounts of various sportsmen believed that such vegetable matter forms their principal diet. He quoted an extensive account by a Mr Wilson who stated that the birds forage on the leaves of trees such as box and oak, and shrubs such as ringal bamboo and one something like a privet. They were also said to eat roots, flowers, insects and their grubs, acorns, seeds, and berries of various kinds, but in small amounts as compared with leaves. In captivity the birds seem to be typical of their genus, consuming primarily vegetable materials, with emphasis on fruit and berries (Howman 1979).

#### *Movements or migrations*

Gaston *et al.* (1981) suggested that this species is relatively sedentary in Himachal Pradesh, showing little vertical movement with the seasons. However, Ali and Ripley (1978) give the species' elevations as breeding above 2400 m (to 3600 m) and wintering at about 1350 m. Wilson (cited by Beebe 1918–1922) also states that in winter the birds are found in the thickest parts of the oak, chestnut, and morenda pine forests having a dense undergrowth of ringal bamboo. But, during the breeding season, they are to be found in the higher parts of the forest, up to the zone of birches and white rhododendrons, and almost up to the extreme limits of the forest.

#### *Daily activities and sociality*

Roosting by these birds is done in trees, preferentially low evergreens, where there are closely inter-

woven leaves and branches, rather than in taller trees. The birds were once normally found in groups of from two or three to a dozen or so, which tended to be rather widely scattered over the forest. Such groups are apparently typical only where the birds are undisturbed; in such cases they tend to remain in ones and twos scattered over considerable distances. At least during the winter the birds seem to be quite sedentary, rarely moving far to forage, but during conditions of heavy snowfall they may sometimes be found on bare, exposed hillsides, in narrow wooded ravines, patches of low brushwood and jungle, and other places where the ground is sheltered from the sun by trees and bushes.

When several are alarmed simultaneously, they all begin to cry at once, and scatter in different directions, with some flying into trees while others flee on the ground. When first flushed they may simply alight in a nearby tree, but after a second flushing they often go some distance, almost invariably downhill (Wilson, cited in Beebe 1918–1922).

Like the other tragopans, the birds disperse in spring, with males establishing territorial calling perches that are well separated from one another. In early April the males are said to be moving a good deal, and they begin to call loudly, usually from a large stone or while perched on the thick branch of a tree, or the trunk of one that has fallen to the ground. During autumn the families gradually begin their descent to wintering areas.

### Social behaviour

#### *Mating system and territoriality*

Ali and Ripley (1978) judged this species to be monogamous, with the male assisting in tending the chicks, even though the incubation was said to be done entirely by the female. This degree of monogamy seems as yet unproven, but it is also unlikely that the species is serially polygynous, as has been suggested by Ridley (in press). Given the relatively short advertisement and breeding season, it seems most likely that monogamy prevails.

Wilson (cited by Beebe 1918–1922) reports that the birds begin to pair in early April, when the males are found well scattered and calling at intervals, sometimes all day long. The calls can be heard for upwards of a mile, suggesting that relatively large territories are held by these birds. However, there are no available estimates of territory sizes.

#### *Voice and display*

Wilson (cited by Beebe 1918–1922) stated that the only calls of the species that he knew of were an alarm call consisting of a series of loud wailing cries sounding similar to the calls of a young lamb or kid,

*waa, waa, waa . . .*, with each syllable uttered slowly and distinctly at first, but increasing as the bird is hard pressed or about to take flight. The male's advertisement call is similar but much louder, with only a single note uttered each time, and similar to the bleating of a lost goat. It may be uttered every five or ten minutes for hours on end, or may be produced only two or three times during an entire day.

Beebe (1918–1922) heard a few other vocalizations of the western tragopan including a call similar to a 'drowsy *waaa-waaaaaaaak!*' of a domestic hen, and a low chuckle uttered by a female approaching its nest.

The lappet colour and pattern may be easily seen from study skins (Fig.11), but there is almost no

detailed information on the species' actual display. Delacour (1977) implies that all species of tragopans have essentially the same display sequence, but this is evidently not true. Nonetheless the display may be quite similar to that of the satyr, its apparent nearest relative.

### Reproductive biology

#### *Breeding season and nesting*

There are few exact dates of nesting for this species, but one nest of six eggs was found on 25 May in Hazara province (now a district of Pakistan), and another nest of three eggs was found on the ground, and was carelessly constructed of grass, small sticks,



**Fig. 11.** Lappet patterns of male tragopans, including satyr (A), Temminck's (B), western (C), Blyth's (D), and Cabot's (E). After photographs of live birds (A and B), or museum specimens.



and a few feathers. The second was on a slanting tree about 10 ft above ground, in a hollow where a large branch had been torn away. The tree was a wild cherry, and about 100 ft or so above a stream on a well-wooded slope. A third nest was found in the Nila Valley of Garwhal and was located under the protection of a small bush in an open glade that was situated in very dense ringal jungle on a steep and rocky hillside. Only fragments of eggs were present. Lastly, a clutch of two eggs was found during June in a tree nest (Baker 1935).

Besides these nests, Beebe (1918–1922) describes seeing a clutch of apparently three eggs collected 4 June in Pir Pangal, Kashmir, and he also observed a female on a still-uncompleted nest 40 ft up in a silver spruce tree in western Garwhal. This nest was evidently an old nest of a corvine bird, to which a lining of spruce twigs, oak leaves and some weeds had just been added.

#### *Incubation and brooding*

There is no good information on this aspect of breeding biology, for western tragopans have only very rarely been bred in captivity (Delacour 1977). Very probably its incubation behaviour and other aspects of the species' nesting biology are the same as those of other tragopans.

#### *Growth and development of the young*

Only a few people have successfully raised young of this species in captivity (Delacour 1977), and there does not seem to be any detailed information on this subject.

#### **Evolutionary history and relationships**

Although this species would certainly seem to be most closely related to the satyr tragopan on geographic grounds, and perhaps also on the basis of the plumage pattern of the male, there is more grey present on both sexes, perhaps as a reflection of the generally drier environment typical of the western tragopan as compared with the satyr. Generally, the satyr tragopan is largely limited to the watershed of the Ganges River, whilst the western is associated with the watershed of the Indus, although no major ecological or physiographic barrier separates the two at present.

#### **Status and conservation outlook**

The known present range of the western tragopan is but a remnant of the original one, which perhaps included some 10 000 km<sup>2</sup> of forest habitat, and is essentially entirely restricted to a small area of Pakistan and Himachal Pradesh, northern India (Gaston, Islam, and Crawford 1983).

In Pakistan, the species is apparently largely restricted to the area between the Jhelum and Kunhar Rivers, of the Hazara district. There are no recent surveys in Swat to confirm its possible occurrence there but skins have been brought out of the area (Mirza 1981a). It may also occur in the Bichela and Bhunja forests of Kaghan Valley, Hazara district. However, the bulk of the population occurs in the Neelum and Jhelum valleys of Azad Kashmir. It apparently still occurs from Reshna to Bor, from Bugina to Phalakan along the ceasefire line, and from Kuttan to Machiara in the Neelum Valley. It has also been reported from Pir Chinase, Pir Hasi Mar, Leepa and Chinari in the Jhelum Valley, and may still occur locally in the Murree hills and Hunza (Islam 1983). Gaston *et al.* (1983) indicated the range in Pakistan as ranging beyond the Kunhar River into the Kangan Valley, based on earlier surveys in Pakistan by Mirza, Aleem, and Asghar (1978), and west to the Jhelum River in the vicinity of Chinari.

In India the birds may occur locally from the ceasefire line of Jammu and Kashmir Pakistan east perhaps to somewhere in Tehri-Garwhal, western Uttar Pradesh, although there have been no sightings in Uttar Pradesh for at least 20 years. In Jammu and Kashmir the birds probably occur very locally along the ceasefire line (Jhelum Valley of Azad Kashmir) and the species still probably occurs locally in Kishtwar (Gaston *et al.* 1983). In Himachal Pradesh it is known to still occur in the upper Beas watershed, especially near Manali, including Solang Nalla, the core area for a proposed national park (Gaston *et al.* 1981). The species was observed once during 1978–79 in the adjacent Ravi Valley to the north, and the Ravi Valley population is probably distinct from the one in the upper Beas Valley. Further east it has been seen in the Simla district, but the upper Beas Valley is probably the species' stronghold in Himachal Pradesh.

Gaston *et al.* (1981) suggested that based on their studies in this region the area of the proposed Manali National Park might support about 50 birds, and that the entire upper Beas Valley might hold no more than 1000 birds. There is no information for the eastern parts of Jammu and Kashmir, for the Dhaula Dhar range in Kandra district, or for western Uttar Pradesh. They judged that unless these areas support unknown populations of birds, the world population of western tragopans must be less than 5000 individuals. More recently Gaston *et al.* (1983) estimated that only 2000–3000 km<sup>2</sup> of habitat still remain that are suitable for the species, and that the world population is perhaps between 1600 and 4800 individuals. This would seem to be an objective assessment, but the actual number may be even



lower than that. Islam (1983) mentioned that the skin of a male is worth from 100–150 rupees (around \$15, or £10), or much more than its value as meat. Grazing, logging, and gathering of branches for firewood all occur in the habitat of the western tragopan as well, and add to the disturbance it now receives, according to Islam. Gaston *et al.* (1983) suggested that three reserves should be established for the species, one each in the main habitat blocks still used by the birds. These include the Neelam Valley, the Inner Seraj area, and a site somewhere in the Ravi-Chenab area still to be determined.

## SATYR TRAGOPAN

*Tragopan satyr* Linne 1758

Other vernacular names: crimson horned pheasant; Indian tragopan; tragopan satyre (French); Rot-Satyrhuhn (German); monal (Nepal); see-a-gea (Chinese Tibetan).

### *Distribution of species*

Himalayas, between about 8000 and 12 000 ft and occasionally 14 000 ft, from Garwhal eastward to Bhutan and forests of neighbouring southern Tibet to Monyul to about long. 92° E. Moves altitudinally, down to occasionally 6000 ft in winter. Occurs in moist and dry temperate coniferous forests (Vaurie 1965.) See map 2.

### *Distribution of subspecies*

None recognized.

## Measurements

Delacour (1977) reported that males have a wing of 245–285 mm and a tail of 250–345 mm, and females have a wing of 215–235 mm and a tail of 195 mm. Fifteen adult males had a wing range of 260–277 mm (average 268.5), and seven adult females had a wing range of 216–245 mm (average 229.5). Males weigh from 3½ lb to 4 lb 10 oz (1600–2100 g), and females from 2¼ lb to 2 lb 10 oz (c. 1000–1200 g) (Ali and Ripley 1978). The eggs average 65×42 mm, and have an estimated average fresh weight of 63.3 g.

## Description (after Baker 1928)

### *Adult male*

Head, crest and a ring round the semi-naked gular pouch black; a streak on either side of the crest, sides and back of neck, upper back and whole lower plumage orange-crimson, the upper back and lower plumage from the breast to the vent with white black-edged ocelli; on the breast and back the spots are small and completely surrounded by black,

towards the vent the spots get larger and larger, less pure and more grey and the black less and less in extent, the spots on the posterior flanks and abdomen becoming large grey spots with black at the bases only; under tail-coverts crimson with white ocelli surrounded by brown, and with black terminal fringes; lower back, scapulars, rump and shorter tail-coverts olive-brown with white black-edged ocelli and black and rufous-buff vermiculations; longer tail coverts amber-brown with subterminal broad black edges; scapulars are profusely marked with crimson, and a few similar marks occur on the back outer rump and tail-coverts; shoulder of wing crimson; coverts like the scapulars, the greater with broad bases of mottled black and buff; inner secondaries like the greater coverts but with no crimson; outer secondaries and primaries deep brown, with numerous broken mottlings of buff; alula quills chestnut mottled with dark brown on the inner webs at the tip. Iris brown, legs pink to greyish white, bill black; horns, orbital skin and lappet Prussian blue; when extended the latter shows a bright sage green edged with four or five triangular patches of brilliant scarlet, the colour probably varying seasonally.

### *Female*

Whole plumage above, under wing-coverts and axillaries rufous-buff or rufous-ochre, vermiculated, barred and blotched with black and with narrow pale ochre central streaks; tail rich rufous-brown with broken buff and black bars, the black grading into the general rufous-brown; the black on the inner webs of the outer tail feathers developing into broad well-defined bars; chin and throat pale or albescent; breast like the back but paler and less richly coloured; still paler on the abdomen and vent, where the central ochre streaks become large white spots. The variation in colour in the females is very great; in some the rich rufous tint is absent and is replaced with grey; the size and brightness of the ochre streaks differ individually; in a few birds there are chestnut markings on the centre of the crown and on the scapulars, wing-coverts and inner secondaries. Iris brown; bill horny-brown; legs fleshy grey-brown.

### *Immature males*

Like female but less richly coloured. Males attain their adult plumage in the second year.

## Identification

### *In the field* (25–27 in.)

This species is most likely to be found in steep hill-sides with scrubby undergrowth and bamboo or in

forests of oak, deodar, and rhododendron. Males are a nearly blood-red throughout, with contrasting white markings on the back and underparts. They most resemble the Temminck's tragopan, but in that species the pale underpart spotting is not distinctly bounded or edged with black. Females are generally rufous brown, with sandy and blackish mottling above and large buffy white spots below that are not distinctly black-edged. The male's courtship call is a loud *wak* or *kya* that is repeated several times in succession, and such sequences of this bleating-like call are repeated at regular intervals. No other species of tragopan is found in the area of the satyr.

#### *In the hand*

The male's strongly reddish plumage, with a bluish face and throat, is distinctive. Females are less greyish than the western tragopan, and very closely resemble the Temminck's, but the tail length is slightly longer (over 180 mm), its underpart markings tend to be more lanceolate, and it tends to be more yellowish orange at the bend of the wing.

### Ecology

#### *Habitats and population density*

Beebe (1918–1922) reported that in Sikkim and eastern Nepal the favourite habitats of this species are narrow side gorges with tiny streamlets flowing down them. In such areas there are overarched tangles of broken bamboo stems, outjutting boulders, forests of rhododendrons and magnolias, and undergrowths of lilacs, primroses, violets, strawberries, and forget-me-nots. Beebe never encountered the birds where the adjacent valleys were dry, and believed the birds to be highly sedentary, probably spending their entire lives on a single range.

Ali and Ripley (1978) stated that the birds are associated with oak, deodar cedar, and rhododendrons on *khuds* and steep hillsides with scrubby undergrowth and ringal bamboo (*Arundinaria*), primarily between about 2400 and 4250 m elevation, but moving down to about 1800 m during severe winters.

Relatively little information is available on population densities, but Lelliott and Yonzon (1981) reported that in a census area of approximately 1.2 km<sup>2</sup> of Annapurna Himal, Nepal, a total of 10 calling male tragopans were recorded in late May. These birds were found there in thick rhododendron mixed forest on both gentle and steep slopes, and were widespread in such habitats between 2750 and 3345 m elevation. During winter the birds moved downward to as low as 2300 m.

#### *Competitors and predators*

Beebe (1918–1922) suggested that although man is certainly the major enemy of satyr tragopans, because of the species' arboreal nature it probably has several important terrestrial predators, including perhaps leopards, foxes, jungle cats, and the larger species of civets. He mentioned a leopard having been shot that had just killed a tragopan. Eagles were also mentioned as possible predators, although in heavy forest cover these would seem unlikely to be efficient hunters. Relatively large numbers of birds are sometimes taken by natives using noose-traps, a device that tends to capture about four or five times as many males as females, according to Beebe.

There are probably no significant competitors except other tragopan species, since the satyr overlaps slightly with the western tragopan on the western edge of its range. It apparently also comes into contact with the Blyth's tragopan at the extreme eastern edge of its range.

### General biology

#### *Food and foraging behaviour*

Beebe (1918–1922) stated that tragopans are omnivorous foragers, but tend to specialize in leaves and buds. Of the crops of these birds that he examined, two held many torn leaves and flowers of the paper laurel, and one of the birds had packed its crop with the petals of rhododendrons, mixed with a few laurel leaves. One of the birds had also eaten a considerable number of insects, including small earwigs, ants, a few spiders, a cockroach, and a centipede. Other workers have suggested that in addition to insects the birds also eat bamboo shoots, onion-like bulbs, wild fruits, rhododendron seeds, and the leaves of daphne and bastard cinnamon. Thirteen birds from Sikkim collected in December all contained leaves and fern materials believed to be of *Diplazium* and *Polypodium* (Ali and Ripley 1978). Lelliott (1981b) suggested that tragopans tend to favour scarce but high-quality foods such as insects or fallen fruits. In captivity the birds are largely vegetarians, with an emphasis on fruits and berries (Howman 1979).

Beebe (1918–1922) reported that like most forest and low-country pheasants the birds usually confine their foraging activities to early morning and late afternoon hours, but on dull and cloudy days they may forage at more irregular intervals. They typically forage on the open edges of the forest, or scratch deep among its undergrowth. Or, they may feed in low trees and bushes, obtaining petals, buds, and berries. When feeding in jungle undergrowth the birds apparently concentrate their scratching in a few likely spots, rather than scratching superficially



and randomly over a wide area as kalij pheasants are inclined to do.

#### *Movements or migrations*

Beebe (1918–1922) stated that these birds seemed to feed on the upper slopes for about two hours during the early morning hours, and then would descend again to spend the rest of the morning in the lower valley. He said that at times a bird would make its way up a ridge for 500 ft or more to its crest.

There are of course much longer seasonal movements typical of this species, and as noted above the birds may winter as much as 1000–2000 m lower than where they occur during the breeding season. Undoubtedly this is a leisurely and gradual migration, the timing of which is certainly dictated by local snow conditions.

#### *Daily movements and sociality*

Beebe stated that, compared with blood pheasants, tragopans are highly solitary birds. He was never able to determine just when the birds went to roost or when they left their nocturnal perches, but did locate one such roost of a male. This was some 12 ft above ground in a moderate-sized magnolia tree, and only a few yards from a gushing spring. During both morning and evening the birds would forage well up on the slope sides, indicating that normally two trips a day would be taken up and down the mountainside. Even during the winter there is little evidence of gregariousness in these birds, although Beebe believed from various reports that females and one or two offspring normally remain together for the greater part of the winter.

### **Social behaviour**

#### *Mating system and territoriality*

Although there is little direct evidence from the wild, it is believed that tragopans are perhaps in the group of pheasant species in which the male remains with a single female only until egg-laying or early incubation, and they may remate with a different female (Lelliott 1981*b*; Ridley in press).

Regardless of this uncertainty, there can be little doubt that satyr tragopans are highly territorial, and during their pairing period of a few weeks in spring the males call from their favourite perch day after day, especially in early morning. Since the birds will often respond to imitations of their call and approach such sounds, it is clear that the call is at least in part a challenge to rivals, and not simply a sexual attraction call to females. Beebe stated that the call is heard only during April and May. This suggests that perhaps there is normally only a single

mating per year, rather than successive matings with different females, in which case one would have expected a much longer or at least interrupted periods of calling. Males sometimes also respond to other loud noises, such as shouts or gun discharges, further suggesting the probability that the call is as much a challenge as it is a sexually motivated signal.

Territorial sizes have not been estimated, but if population densities approximate 10 males per km<sup>2</sup> the area defended might approach 100 000 m<sup>2</sup>, or about 25 acres per male.

#### *Voice and display*

Beebe's (1918–1922) description of the male challenge call is excellent; he describes it as a weird, full-throated cry, that is deep, half-booming, and half-bleating. At a distance of 50 yds or more it sounds like *wah, waah! oo-ah! oo-aaaa!*, with the last tone sometimes drawn out into a heartrending crescendo wail. The syllables usually run together so as to seem a single utterance. Wayre (1969) stated that the male utters 12–14 such notes, the series gradually rising in volume until it becomes almost a shriek, and the entire sequence lasting for 20–25 s or more. Unlike the Temminck's tragopan this call has no terminal growl or croak, according to Wayre.

Lelliott (1981*b*) distinguished four types of call, which he considered to be an incomplete description of the species' vocalizations. The first is the '*wah, wah*' call, which is a repeated monosyllabic note uttered by both sexes and is uttered at any time of the day during spring and autumn. The function of the call is uncertain, although it may relate in part to courtship it may also have other functions, including possible male-to-male aggressive signalling. The second call, the *wak, wak* call, is similar to the first, but is of lower amplitude and thus less audible. It was observed to be uttered by both sexes when alarmed after disturbance by humans and possibly other enemies. Most commonly it is uttered during flushing; more than half the birds flushed by Lelliott were heard to utter this call. The third type of call recognized by Lelliott is the '*bleat*' note. This is a short, monosyllabic note similar to the bleat of a sheep or goat, and often precedes wailing. The call was heard only during the breeding season, suggesting that it functions in pair formation or courtship. The '*wail*' call is a drawn out mammal-like call made by the male only, and consists of the repeated series of notes mentioned earlier, and ranging up to 33 s in length. Calling is greatest at dawn; its onset is closely related to the time of sunrise. Lelliott judged its function to be uncertain, but that it might be related to territorial advertisement.

Lelliott observed display in wild birds on only one



occasion, when bleating and wailing calls were heard in conjunction with wing-whirring and with an observation of copulation. During the breeding season he observed the birds most often as single males or single females (58 per cent), less often in pairs (17 per cent), and otherwise in unknown social combinations. He judged that the mating system is still uncertain, but perhaps it is normally a monogamous species.

There are relatively few detailed descriptions of the displays of the satyr tragopan, but Beebe (1918–1922) quoted an account provided to him by Mr Barnby Smith that is worth quoting in full:

The lateral display of a cock Tragopan in good plumage is interesting; that is, he presents one side of the head, body, and tail to the hen, and lowers one wing and raises the other until he almost looks like the mere skin of a bird stretched flat on a wall. This pose is constantly assumed during the breeding season (from February onwards), the cock taking up a position about a yard distant from the hen and repeatedly assuming a new position if she moves off.

This lateral display, however, is as nothing compared to the frontal display, which I usually notice some three or four times each season. In this case the cock faces the hen (about two or three yards distant) and commences by crouching down slightly, ruffling his feathers and spreading his wings, which are slowly flapped on the ground. The head is nodded repeatedly with increasing speed and the brilliant light blue horns gradually become inflated and extend forward from the black feathers of the head, whilst the bib (or gular wattle), which is also blue with pink side stripes, is gradually let down to its full length. Whilst this is being done the shivering and the rustling of the feathers have increased to an alarming extent, the body of the bird has been lowered quite near the ground, the wings are extended sometimes almost to their full width, and the whole business is preceded and accompanied (particularly in the early stages) by a curious noise like the 'clacking' of two bones together, but how this noise is made I have never found out, though I should much like to know. When the bib has been extended to full length for a few moments the bird gathers himself together, moves forward about a yard, draws himself up to his full height (and it is surprising how high he can reach), keeps the bib fully extended in front of the hen for one moment, and then, within half-a-minute, horns and bib have entirely vanished and the cock is strolling about pecking grass as if nothing unusual had happened.

Likewise, various other observers such as C. Seth-Smith have described the major display as being a forward run with body held erect, emerging from the darkness of some undergrowth, and spreading the breast and flank feathers like a skirt while exposing the large blue and red lappet (Fig. 11).

Wing-flapping is apparently also part of this frontal display (Fig. 12) of the satyr tragopan. As with the other tragopans, the lappet is displayed for only a

few seconds, and shortly thereafter the horns retract, the lappet is contracted and both disappear again into the crown and throat feathers. Although the male's calling is evidently normally done from an elevated perch, full male display is seemingly performed on the ground, presumably after a female has been attracted to the male's vicinity by his calling. Quite probably copulation attempts normally follow such a running approach to the female. Thus, Lelliott and Yonzon (1980) observed copulation in a pair of wild satyr tragopans in mid-May, after a male had 'fanned its tail, opened its wings slightly, and quivered violently while lowering its wings to the ground and raising its tail'.

## Reproductive biology

### *Breeding season and nesting*

Little is known of the breeding season in the wild state, but it evidently occurs during May and June, or about a month later than the peak of male calling. Baker (1935) has provided the best summary of nesting. He described a clutch of two eggs found in the Chambi Valley near the Tibet border, in a rhododendron- and oak-forest. The nest was located in a tree about 20 ft above ground, and well hidden from view. The forest was very thick but stunted, and the ground greatly broken up with huge rocks covered by mosses and fern. The nest was a jumble of old, dead twigs and branches that were mostly rotten, and it was judged that perhaps an old mass of sticks had been found and converted into a nest. Another nest in the same area was similar but was empty and closer to the ground. Natives of the area stated that two eggs were usual in the clutch, and that never more than four are present. Baker believed that in the wild the nesting season begins in early May and extends through June, with some birds in the highest elevations not laying until July.

Nests made by captive birds in Mr W. Shore Bailey's collection were typically stick-like and placed in open baskets put up in apple trees at heights of 10–20 ft above the ground. The nesting season in captivity is more extended than in the wild, and frequently eggs will be laid on the ground and subsequently ignored. The eggs are rather variable in colour, but typically are reddish buff, with a freckling of deeper brick-red over the larger end or the entire surface. Delacour (1977) stated that old nests of crows or other birds may be used as nest sites, although female tragopans do a good deal of nest-building and nest-lining themselves.

In captivity, the eggs are typically laid on alternate days, until the female has a clutch of 4–6 eggs. If the eggs are taken away from the female immediately, she will often lay a replacement clutch, and this



**Fig. 12.** Postures of male satyr tragopan, including wing-flapping (A), wattle engorgement (B), normal resting posture (C), and calling posture (D). After photographs of live birds.

may be repeated three or four times in a single season (Delacour 1977).

#### *Incubation and brooding*

The incubation period is typically 28 days, and when the chicks emerge they are able to survive without any food for their first 48 h. However, they do need water about 12 h after hatching. The birds are highly precocial at hatching, and within two or three days are even able to fly up to an elevated perch, where they typically roost under their mother's wings (Wayre 1969).

When rearing the chicks in captivity, their early

food should consist of bread and milk, ant eggs, various insects, hairless caterpillars, and small worms. Later on they can be fed finely chopped greens, and gradually they may be provided a mixture of crushed hemp, small groats, and broken wheat. Apparently they should not be fed seeds, starchy foods, or boiled eggs until they are at least 12 days old. Since female tragopans feed their chicks only one or two insects at a time, after having carefully softened them with their bills, the young birds should only be fed soft-bodied insects (Delacour 1977). Sivelles (1979) has provided additional information on feeding young tragopans in captivity.



### *Growth and development of the young*

In the wild the brood probably remains with its mother for most or all of their first year, and likewise in captivity the brood may be kept together for their first year. Males typically will not develop their full plumage in their first year, although some will develop more quickly and rarely may be able to breed when only a year old.

### **Evolutionary history and relationships**

There seems to be little doubt that the nearest relative of this species is Temminck's tragopan, for the male plumages of these two species are extremely similar, although their lappet patterns are quite different. The satyr tragopan is also somewhat intermediate between Temminck's tragopan and the western tragopan, both in its geographic distribution and in the intensity of black on the male's underparts. These three species seem to me to represent one superspecies group in the genus *Tragopan*, while the Blyth's and Cabot's appear to comprise a second group.

Relationships of *Tragopan* to other genera of pheasants are far less certain. There is indeed some question as to whether the tragopans should be included with the pheasants or the partridges (von Boetticher 1939), and at minimum it seems clear that this is a rather isolated genus, without any close relatives except perhaps the blood pheasants (Cheng *et al.* 1978).

### **Status and conservation outlook**

The satyr tragopan is a favoured food of the local inhabitants in many areas, and is heavily trapped by them in Nepal by noose traps (Beebe 1918–1922). Yonzon and Lelliott (1981) reported more recently that in their studies the second highest trapping toll of pheasants in the Annapurna Himal area of Nepal was of satyr tragopans, which comprised about 36 per cent of the trapping take. Likewise, among pheasants shot with guns the tragopan kill was second highest, and the altitudinal zones in which the birds occur are those favoured by both professional and amateur hunters. Because of hunting pressures the pheasant populations are declining, and as the hunting pressures increase areas of previously nearly untouched steep terrains, the favourite habitats of tragopans, are increasingly being exploited for hunting purposes. Hunting in Nepal is carried on throughout the year, with no restrictions on the age or sex of the game. Thus, in Nepal as well as in India, it is likely that the satyr tragopan will continue to decline in numbers unless better conservation measures are instituted. The satyr tragopan is

one of four species of birds now accorded legal protection in Nepal (the Himalayan monal being the other pheasant in the group), but this does not actually provide much help towards its survival (Roberts 1981).

### TEMMINCK'S TRAGOPAN

*Tragopan temmincki* (J. E. Gray) 1831

Other vernacular names: Chinese crimson horned pheasant; tragopan de Temminck (French); Hornhuhn, Temminck-Satyrhuhn (German); kiao-ky (Chinese).

#### *Distribution of species*

Eastern Himalayas, at about the same elevations as *T. satyra*, and forests of neighbouring southern Tibet, from about long. 93° 30' E. (and probably farther west to the upper reaches of the Subansiri River), eastward through south-east Tibet and Sikkang to the mountains of western and northern Szechwan, southern Kansu (perhaps), southern Shensi and northern Hupeh, southward to north-east Burma, and Yunnan (where it breeds up to 15 000 ft) to extreme northwestern Tonkin. Dense evergreen or mixed mountain forests and dense rhododendrons and bamboos (Vaurie 1965). See map 2.

#### *Distribution of subspecies*

None recognized.

### **Measurements**

Delacour (1977) reported that males have wing lengths of 225–265 mm, and a tail length of 185–230 mm, while females have wing lengths of 220–225 mm and a tail length of 175 mm. Cheng *et al.* (1978) report five males with wing lengths of 210–242 mm and tail lengths of 200–232 mm, and five females with wing lengths of 202–218 mm and tail lengths of 158–178 mm. The males ranged in weight from 980–1120 g, and the females from 970–1100 g. Two captive males weighed 1362 and 1447 g, and two females 907 and 1021 g. (D. Rimlinger, personal communication). The eggs average 54×40 mm, and have an estimated fresh weight of 47.7 g.

### **Description (after Baker 1928)**

#### *Adult male*

Forehead, lores, anterior crest, ear-coverts, sides of head and feathers surrounding gular skin black; posterior crest, centre of crown and nape, neck, extreme upper back and upper breast deep orange-red, changing to crimson-maroon on back, rump, and shorter



upper tail-coverts, the latter parts with ocelli of pure grey surrounded with black; longer tail-coverts dull pale red, the centres paler and greyish and the tips darker and richer red; all the feathers of the upperparts have their bases mottled blackish brown and buff, showing through here and there; tail buff with a broad deep brown terminal bar and with numerous narrower bars and mottlings of the same colour; wing-coverts like the back but with larger ocelli; edge of wing and alula area light brick-red; quills brown barred and mottled, especially on the outer webs, with rufous changing to buff on the secondaries; on the innermost secondaries there are large ill-defined ocelli and some crimson splashes; below the orange-red changes to Indian-red, paling again on the posterior flanks, thighs and under tail-coverts, the vent and centre of the abdomen almost yellowish red; all the feathers of the lower plumage have clear grey central spots. Iris brown; bill black, paler at the tip; legs and feet pink or reddish, darker in the breeding season; horns light peacock-blue; face and orbital skin light blue; lappet blue mottled with light blue spots centrally, and with about eight reddish markings of irregular shape on each side.

#### *Female*

Whole upperparts mottled black and dull to bright rufous; wing coverts, scapulars and back with arrow-shaped marks varying from white or pale grey to bright cream-buff; on the neck the marks are obsolete and on the crown become longitudinal and spatulate in shape; tail like the back but the markings form irregular bars; chin and throat unspotted buffy-white to rich buff; front and sides of neck buff or rufous, the feathers edged with black; breast mottled with black or dark brown and fulvous with whitish centres; abdomen paler with more conspicuous white spots, vent, thighs and under tail-coverts with finer, duller mottling. Iris brown. Bill horny. Orbital skin bluish. Legs fleshy grey (Delacour 1977).

#### *First-year male*

Like the female, but larger, and with some black and red on the head, and red on the neck and upper breast.

#### *Juvenile*

Much like the female.

### **Identification**

#### *In the field (25–27 in.)*

This species is found in the thick undergrowth of dense montane forests, and like the other tragopans is highly arboreal. Males resemble those of the satyr tragopan, but the pale spotting on the flanks and

underparts is greyish and lacks the black edging of the satyr, producing a less contrasting plumage pattern. Females cannot be readily separated in the field from those of the satyr. The male's courtship call is a plaintive series of increasingly louder *waaa* notes, lasting from 8 to 16 s.

#### *In the hand*

Males are easily separated from the similar satyr tragopan by their greyish rather than white underpart spotting, which lacks black borders. In females, the light spots are large and oval rather than lanceolate, and have a border of yellowish buff. Females also resemble Cabot's tragopans, but are generally more fulvous than greyish, and typically exhibit bluish orbital skin rather than being reddish to orange in this area.

### **Ecology**

#### *Habitats and population densities*

Beebe (1918–1922) has summarized the relatively small amount of information he could learn about the habitats of this species. In Szechuan it can be found in heavy hardwood forests that are rich in undergrowth and occur between 3000 and 9000 ft. It prefers steep mountain slopes that are rich in arborescent vegetation. However, in Yunnan, Beebe observed the species in an area of stunted rhododendrons and bamboo stubble on a steep mountainside.

In Tibet, Ludlow and Kinneer (1944) found this species to be abundant in Packakshiri between 7000 and 12 000 ft, occurring among thick rhododendron and bamboo undergrowth in the densest forests. Delacour (1977) stated that in Tonkin he never found them below 8000 ft, and that they seemed to prefer hardwood forests along sharp ridges and slopes, with thick undergrowth and moss-covered trees.

There do not appear to be any estimates of population density available.

#### *Competitors and predators*

So far as is known, there is almost no contact with any other tragopan in this species range. Cheng (1979) states that it occurs in company with Cabot's tragopan at the extreme western limit of that species' range in north-east Kwangsi, but it is the rarer of the two forms there. It also closely approaches the range of Blyth's tragopan in southern Tibet; Cheng *et al.* (1978) show locality records of the two species occurring less than 100 km apart. Ludlow and Kinneer (1944) judged that the Subansiri–Manas watershed (Dafla Hills) may be the dividing line between the satyr and Temminck's tragopans in the vicinity of the Bhutan border.

Nothing specifically has been noted of their predators, which probably include the usual large raptors and various predatory mammals of eastern Asia.

## General biology

### *Food and foraging behaviour*

Beebe (1918–1922) has summarized what little is known of foods in the wild. Reports from China indicate that birds there eat frozen fruits and berries in the winter, and more generally consume grain, berries, and fruits of *Cotoneaster* and allied shrubs, and maize. Beebe noted that a bird he shot in late fall had a crop that was filled with a mass of comminuted leaves and an almost equal amount of macerated insects. The insects were unrecognizable, but two small spiders that had just been swallowed were identified. A bird that was shot during May in Tibet had been feeding on the unopened flower-buds of *Berberis nipalensis* (Ludlow and Kinnear 1944).

In captivity the birds are primarily vegetarian, with a special fondness for fruit and berries (Howman 1979), as well as peanuts (Sivelle 1979).

### *Movements or migrations*

Nothing specific seems to have been written on this, although doubtlessly the same kinds of vertical migration occur in this species as in other tragopans and high-montane pheasants.

### *Daily activities and sociality*

The few observations of this species in the wild suggest that the birds occur singly or at most in very small groups, perhaps pairs or family units. Their daily activity cycles are probably much like that described for the western and other tragopans.

## Social behaviour

### *Mating system and territoriality*

Presumably these birds show the same kind of relatively monogamous mating system that apparently is typical of the other tragopans. Males utter a very loud cry during the spring, as do the other species. Beebe (1918–1922) judged that males spend the winter solitarily, and that their calling serves both as a challenge to other males and as an attraction to females. He noted that in captivity a male and female will call to each other periodically during the day if they are separated, but that the female always remains silent when she is in the same enclosure as the male. However, captive females have been observed calling while in the same cage as the male (Kenneth Fink, personal communication).

### *Voice and display*

The male's challenge call has been described as a *ona*, twice repeated (Beebe 1918–1922). It has also been characterized as a single plaintive note, *waaa*, repeated four to eight or more times, rising in pitch and becoming louder and more insistent, like somebody crying for help. The sequence may end with a croak on a lower note or a disyllabic growl of far less carrying power. The entire sequence may take from 8–16 s. (Wayre 1969).

Beebe's (1918–1922) description of the display, as consisting of three separate phases, has been widely quoted, but does not seem to agree well with recent observations by the author or by David Rimlinger (1984), a keeper of birds at the San Diego Zoo. Based on our individual observations, as well as analysis of videotapes of a captive pair of birds, the major phases of display may be summarized in some detail here as a basis for future comparison with other tragopan species.

Rimlinger classified the male tragopan displays he observed into two major categories, lateral and frontal. During lateral display (Fig. 13), the male flattens his body feathers, and raises the wing opposite the female, while slightly lowering the nearer one. In an upright posture, the male thus slowly walks around the female, occasionally 'freezing'. Or, the male may walk up to a female and arch his head down toward the ground, slowly side-stepping toward the female. Although the posture is similar to tidbitting in typical pheasants, the male neither offers the female food in this posture nor takes any for himself. Lateral displays may also be used as threats toward other males or toward reflections in a mirror.

Frontal display, by comparison, is much more complex and is highly stereotyped (Fig. 14). It typically begins from behind a solid object, such as a large rock. Typically, the male starts by walking behind the rock and peering over it toward the female. He may stand there for a time, or immediately begin the display sequence by twitching his head vertically, gradually exposing the colourful throat lappet and expanding his 'horns'. The tail is then spread and the wings begin to beat. As the wings are beaten the horns vibrate, and the orange-coloured upper wing-coverts become visible. This first phase lasts about 19 s, and is terminated by the onset of calling and head-jerking. The calling phase lasts only about 14 s, and during it the wings are beaten but the body is held rather still, with the head lowered and the bill resting on the lappet. As calling begins the male crouches down until he is nearly out of sight of the female momentarily. The calls are repeated clicking or gasping sounds, and the wing beats, which begin as fairly slow shallow movements, are synchronous with the calls, both of





**Fig. 13.** Postures of male Temminck's tragopan, including normal resting posture (A), partial lappet engorgement (B), upright lateral display (C), and arched lateral display toward a female (D and E). After photographs of live birds.

which speed up to a rate of about five calls and wingbeats per second. The third and final phase consists of the bird suddenly hissing, rising up as high on tiptoes as it can reach, pushing the wings downward, pointing the beak downward, and spreading the lappet maximally as the horns are held erect. This fantastic posture is held only momentarily, after which the bird sinks back down, the lappet retracts, and a normal posture is assumed. This climax phase lasts only about 3 s. In a small proportion of the sequences (10 of 35 sequences observed by Rimlinger), the male may complete the sequence by run-

ning over the top of the rock with his lappet and horns extended, and his wings and tail spread and scraping the ground, accompanied by a hissing sound. The male may thus chase the female a short distance, or may simply stop where she had been standing. It is possible that copulation normally follows such a rush, but the behaviour has not yet been described in the Temminck's tragopan. It is known, however, that copulation in the closely related satyr tragopan may occur after a very similar display sequence and rush (Lelliott and Yonzon 1980).



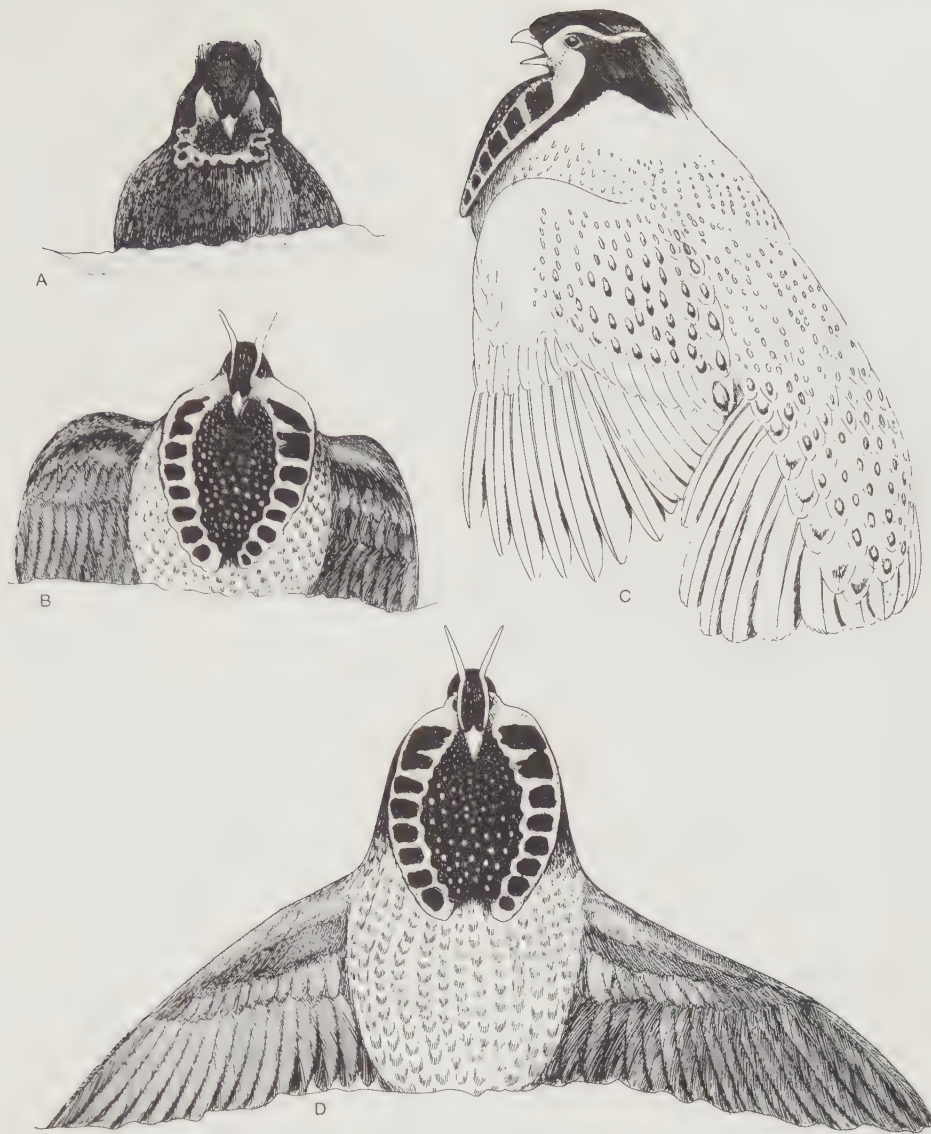


Fig. 14. Frontal display of male Temminck's tragopan, including preliminary posture behind rock (A), wing-flapping phase from in front (B), wing-flapping from the side (C), and start of final rearing phase (D). After photographs of live birds.

This bizarre display is totally different from that known for any of the true pheasants, and is also distinct from that of any known partridge species, supporting the view that the genus *Tragopan* is very isolated in the pheasant family. Rimlinger has also observed a few other apparent displays, including a short display flight to an elevated perch. This also is unusual behaviour for pheasants, but is the presumed evolutionary precursor to stationary wing-whirring, which has also been observed in the species.

### Reproductive biology

#### *Breeding season and nesting*

Little is known of the nesting season in the wild, but chicks have been collected in Tibet during early July, (Ludlow and Kinnear 1944), suggesting that incubation began about 1 June. In captivity laying typically begins in early April, and continues until early May, with later layings in June and July the result of earlier nesting failures or removal of earlier clutches. Nests are probably normally elevated,

although the single nest of a wild bird that has been described from China was a ground nest containing an unusually large clutch of six eggs (Beebe 1918–1922).

Beebe (1918–1922) made the interesting point that when his females were provided with elevated nesting sites they laid clutches that averaged smaller than when they laid eggs on the ground. In seven cases females laid three to six eggs in ground nests, while the same birds laid only one or two eggs in elevated nests. He judged that the small clutch of tragopans was perhaps adaptively related to the small available platform of most elevated nests, and also mentioned that tragopan eggs are unusually large for the size of the female. This he attributed to the advantages of having the young hatch at a highly advanced state so that they can flutter down from a tree nest or up to elevated perches shortly after hatching. He considered this precocial behaviour typical of tragopans, peafowl and monals, all conspicuous jungle-dwelling species that he believed might have a special need to be able to escape by flight.

#### *Incubation and brooding*

Incubation is by the female alone, and requires 26–28 days, rarely to 30 days, one of the longest incubation periods in the pheasant group. Within two or three days after hatching the young are easily able to fly up to elevated perches, where they typically roost beneath their mother's wings in the manner of peafowl and argus pheasants. However, the chicks actually grow relatively slowly, and are quite sensitive to disease and chilling. The full adult male plumage is not attained until the second year (Delacour 1977).

#### **Evolutionary history and relationships**

There seems little doubt that the nearest relative to the Temminck's tragopan is the satyr. The birds hybridize in captivity extremely freely, and the offspring are full fertile (Sivelle 1979). The two species now very closely approach one another geographically, but are not known to overlap in distribution.

#### **Status and conservation outlook**

This species has by a considerable measure the largest range of any tragopan, and thus its safety seems to be the most secure. However, it is extensively trapped or shot for its feathers, its flesh, or for keeping in captivity, and more importantly its habitat of mature montane forests is in many areas being cut for timber or razed for agricultural purposes. Thus, like the other tragopans, it is quite vulnerable to population destruction over large areas of its range.

#### **BLYTH'S TRAGOPAN<sup>1</sup>**

*Tragopan blythi* (Jerdon) 1870

Other vernacular names: grey-bellied tragopan; tragopan de Blyth (French); Blyth-Satyrhuhn (German); hurr-hurrea (Assamese).

#### *Distribution of species*

The mountains of Assam and north-western Burma; the hills south of the Brahmaputra from the Barail Range and the Naga Hills eastward through the Patkoi Range into northern Burma and south-eastward through Manipur into the Chin Hills; also eastern Bhutan and south-east Tibet. In forests between 6000 and 12 000 ft. See map 2.

#### *Distribution of subspecies (after Ripley 1961)<sup>2</sup>*

*Tragopan blythi blythi* (Jerdon): eastern Blyth's tragopan. Assam south of the Brahmaputra River in the Patkoi, Naga, and Barail Ranges, south to Manipur, Lushai Hills, and the adjacent hills of Burma, from 6000 ft up; in moist temperate forest. Now largely limited to Nagaland.

*Tragopan blythi molesworthi* Stuart Baker: western Blyth's tragopan. South-east Tibet, Bhutan, and the upper ranges of the Assam Hills east to the Mishmi Hills, from 6000 to 12 000 ft; in moist temperate and coniferous forest. Current distributional and numerical status uncertain.

#### **Measurements**

Delacour (1977) reported that males of *blythi* have a wing length of 260–265 mm and a tail of 180–220 mm, while females have a wing of 230–245 mm and a tail of 170–175 mm. Adult males are reported to weigh 1930 g, and females 1000–1500 g. (Zeliang 1981). The eggs average 58.5×44 mm and their estimated fresh weight is 62 g. The two known male specimens of *molesworthi* have wing lengths of 250 and 260 mm, and tails of 180 and 195 mm (Delacour 1977 and personal observations). A single female had a wing of 232 mm and a tail of at least 155 mm (Biswas 1968).

#### **Description (after Ali and Ripley 1978)**

##### *Male (of blythi)*

Forehead, crown, a patch down either side of neck and feathers round the naked orange-yellow face, black. Broad supercilia to nape, hindcrown, neck, upper back, and 'shoulders' bright crimson. Rest of

<sup>1</sup> Rare species (King 1981).

<sup>2</sup> Koelz (1954) has described an additional race (*rupchandi*) that was not recognized by Ripley.



upper plumage brown, tinged with red and contrastingly marked with numerous white and maroon ocelli. Feathers around the naked yellow gular patch, black. Adjacent upper breast bright crimson, contrasting with smoky grey lower breast and belly, the feather centres paler grey. Flanks and thighs mottled black and buff and splashed with crimson as on vent. Iris brown. Bill horny brown. Bare face golden yellow. Horns light blue. Lappet yellow, bordered with blue. Legs pink or reddish.

#### *Female*

Rather like *satyra*, but paler. Upperparts black, narrowly barred, blotched and stippled with rufous and vermiculated with buff. Tail paler and more rufous. Underparts, mottled, stippled and spotted with dark brown, rufous, and greyish white. Centre of abdomen and vent more uniform grey. Iris dark brown, edges of eyelids lemon yellow. Maxilla black, browner at base; mandible very pale horny. Legs and feet brownish horny; claws horny; pads white.

#### *Immature male*

Similar to adult female, but with red on the head.

#### *Juvenile*

Both sexes like female, but male acquiring red on the neck at the first spring moult. Full adult plumage is not attained until the second year of life.

### Identification

#### *In the field* (25–27 in.)

This species is found in the thick undergrowth of dense evergreen montane forest, and males are distinctive in being almost uniformly grey underneath, while the neck, chest and head are mostly orange-red. The male's courtship call is a sonorous *wak*, sometimes lengthened to *wa ak-ak* producing a sort of two-toned effect. Females are also distinctly greyish on the undersides, and are dark olive brown above, with a whitish chin and throat. They are probably not separable from those of the Temminck's tragopan in the field, but it is unlikely that any other species of tragopan occurs in the area occupied by this species.

#### *In the hand*

The uniformly grey underpart colouration of males, and the yellowish facial skin, provide for immediate identification. Females are most similar to those of the satyr tragopan but are paler, have yellowish orbital skin, a more greyish underpart colouration with white ocelli on the feathers of the mid-belly, and the dorsal feathers have distinct black lateral ocelli.

### Geographic variation

The westernmost population of Blyth's tragopan is apparently recognizably distinct from the remainder of the species' range, but is so far known only by three specimens. The type specimen of *molesworthi* was described as being darker on the upperparts, with browner red ocelli, narrower buff vermiculations, smaller white spots, and generally paler on the underparts than in the nominate race. Apparently only two additional specimens of the race have since been obtained. One of these, a female, is darker than those of the nominate form and is generally more greyish and less reddish on the upperparts (Biswas 1968).

### Ecology

#### *Habitats and population density*

Very little has been written of this species in its natural habitat, but Beebe (1918–1922) quoted extensively from unpublished notes of E. C. Stuart Baker, who observed the birds in North Cachar, in an area of the Barail Range adjoining the Naga Hills ranges. The area where the birds were seen was at 6000 ft, in densely wooded valleys occurring below such peaks as Mahadeo, Hengmai, and Hungrum, and the vegetation at the bases of these mountains is luxurious and massive, with some trees over 100 ft tall. Above 4000 ft the vegetation begins to become more scanty, and from 5000 ft upwards the major trees are stunted oaks rarely more than 30 ft tall. However, a variety of epiphytes drape the trees, including mosses and orchids such as *Coelogyne*, *Dendrobium chrysotoxum* and *D. densiflorum*. The forest floor is covered by bracken and other ferns of all kinds from maidenhair to palm ferns, as well as various bigonias and wild jasmine. The environment is quite moist, with many seasonally turbulent mountain streams.

The nominate subspecies has been recorded as low as about 5000 ft during the winter dry season, and apparently summers in the moist temperate montane forest zone between 6000 and about 10 000 ft. The northern race *molesworthi* has been locally recorded in south-east Tibet (in mountains north of Dibrugarh in Assam) and probably extends southwards in these mountains through eastern Bhutan and northern Assam at elevations between 6000 and 12 000 ft in moist temperate and coniferous habitats comparable to those of the nominate form.

There are no studies of population densities, but the birds are now rare everywhere. In Pulibadze sanctuary in Nagaland, an area of 9.23 km<sup>2</sup>, about 40 birds were present (Zeliang 1981) suggesting a density of about four birds per km<sup>2</sup>.



*Competitors and predators*

There is no specific information available on predators and competitors. The forests of Nagaland support a wide array of feline predators, including tigers, clouded leopards, and panthers, as well as other smaller cats and various mustelids, all of which might be potential predators.

Blyth's tragopan may well encounter and compete with the satyr tragopan at the extreme western edge of its range in Tibet and in Bhutan or adjoining Assam, but there is no direct evidence of this. It also closely approaches or may actually encounter the Temminck's tragopan in south-east Tibet (Cheng *et al.* 1978), while the nominate form likewise approaches this species near the Assam–Yunnan border. Delacour (1977) reported that there is a possible hybrid specimen apparently involving these two species from the Shweli–Salween Divide area of western Yunnan that is in the collection of the American Museum of Natural History.

**General biology***Foods and foraging behaviour*

Baker (1935) stated that in the wild these birds feed on all kinds of seeds, berries, fruits, and buds, while his captive birds greedily ate worms, insects, and even small frogs. Beebe (1918–1922) states that captive birds will eat berries, worms, and unhulled rice. Howman (1979) indicates that in captivity the species is primarily vegetarian, but with an emphasis on fruit and berries. The only known female specimen of *molesworthi* was collected while foraging in the undergrowth of a rhododendron forest, and its crop was filled with freshly consumed plant materials, including the leaves and fronds of ferns, leaves of *Spiraea*, those of *Herpetospermum caudigerum* (Cucurbitaceae), the leaves of a species of Ranunculaceae, and a variety of other leaf fragments, shoots, petioles, and leafbuds, but no animal materials (Biswas 1968).

Apparently the birds make daily movements up and down the mountain slopes in trips between roosting sites and foraging areas, following paths along which natives often set snares (Beebe 1918–1922).

*Movements or migrations*

Apparently the seasonal movements of this species are often not very great, for where they occur the winters are not severe, and they are more prone to move down the mountainside during the winter to avoid the drying out of vegetation associated with the dry season than to escape cold weather. Beebe suggested (1918–1922) that during the breeding sea-

son the rains are so intense that nesting above the ground is advantageous inasmuch as seasonal rains may cause flooding or even sweep clean many of the slopes in the areas where these birds breed.

*Daily activities and sociality*

There is no specific information on this, but is probably no different from that described for the other better known tragopans. Baker (1925) stated that the birds move about in small parties of four or five birds, although natives of Nagaland reported that the birds are always to be seen in pairs, both in and out of the breeding season.

**Social behaviour***Mating system and territoriality*

The Blyth's tragopan male advertises in the usual tragopan manner, and it is assumed that one or more females are attracted to individual males when mating. Zeliang (1981) suggested that the males are 'selective in their choice of mates', and that the male guards the female while she is within his territory. These comments would suggest a monogamous pair bonding system.

*Voice and display*

The territorial advertisement call of the male has been described in various ways. Thus, it has often been called a fine, sonorous *wak*, sometimes lengthened into a *wak-ak-ak* reminiscent of that of a peacock, although much less harsh. Zeliang (1981) described it as a deep bass sound, *mao, mao*, uttered in early morning and again in the evening. The only sound attributed by Zeliang to the female was a sharp musical quacking call. He said that the 'mating season' is in March.

E. C. Stuart Baker (quoted in Beebe 1918–1922) has provided the only detailed description of the frontal sexual display of the male, based on the observation of a wild bird. It is worth quoting in full:

For a few minutes the two birds, male and female, scratched about the hill just like a pair of barndoor fowls, now and then picking up an insect disturbed from under the pebbles, or seizing a grasshopper from the scraps of herbage scattered about over the bare ground. But presently, ceasing to take any interest in the abundant food all about him, the cock bird began to attempt to attract the attention of the hen by all sorts of antics and displays. At first he merely came up to her and bowed and scraped with his wings slightly raised, and his purple-blue horns fully dilated and projecting forward. Then, seeing that she took no notice, he depressed his wings and walked slowly around her, nodding violently as he walked and swelling out his throat and breast, the feathers of which were ruffled and standing almost on end. After a short time of this

ineffectual display he once more stopped in front of the hen, and standing still, leaned forward until his breast almost, or quite, rested on the ground; he then extended both his wings, so that their upper portions faced the same way as his head, and stood thus for some seconds—a blaze of deep crimson, with his weirdly shaped horns quivering with excitement, and his wattles displayed to the fullest possible extent. Then suddenly his feathers collapsed, his horns nearly disappeared; he held himself erect, and once more quietly commenced to scratch and feed until he and his mate shortly disappeared into the adjoining forest.

As far as I could see, the hen bird took little or no interest in the display of the male, and continued serenely feeding all the time it was going on, but this was perhaps only a ladylike way of inducing him to exert himself to the uttermost. Both birds constantly uttered a soft, chuckling

note, and now and then the cock bird gave a rather loud *quawk*.

This description differs in some respects from what is known of the display of Temminck's tragopan, as for example in not being performed from behind a stone or other partially obscured location. There also does not seem to have been a rush phase, as apparently often occurs in the satyr tragopan and less frequently in the Temminck's tragopan. Lateral sexual display that is similar to that described for the Temminck's tragopan, also evidently is present in this species, judging from published photographs (Fig. 15).



**Fig. 15.** Postures of male Blyth's tragopan, including lateral display to female (A), erect posture (B), and crouching during lateral display (C). Drawings A and C are after photos from the Zoological Society of London.



## Reproductive biology

### *Breeding season and nesting*

According to Baker (1935), the breeding season begins in early April, and lasts well into May. No nests have been definitely found in the wild, but natives in Nagaland stated that they are always placed in trees, stumps, or small bushes, and are never on the ground. Their heights are said to range from 6 or 7 to 20 ft above ground, and are made of good-sized sticks, with a lining of smaller twigs and sometimes grass or weed stems. A favourite nesting site is said to be one hidden among masses of creepers growing over some dead tree, or at times the nest may be placed in the fork of a leafless sapling, and thus quite visible (Baker, quoted by Beebe 1918–1922). Doubtless as in other tragopans the birds normally use old nests of other birds, and thus their actual locations largely depend on the availability of such sites.

The clutch size in the wild has been reported as consisting of two to five eggs, usually three or four. Baker (quoted by Beebe, 1918–1922) confirmed this as typical also of his captive birds. Zeliang (1981) stated that in captivity females lay from two to six eggs. He noted that, over various years, a total of 25 females laid 76 eggs, or an average of 3.1 eggs per female.

### *Incubation and brooding*

Zeliang (1981) reported the incubation period as ranging from 36 to 45 days, which is far greater than that reported for any other pheasant, and is probably in error. More probably it is closer to the 28 days considered typical of tragopans in general.

### *Growth and development of the young*

The only quantitative data on the avicultural aspects of hatching and survival of young are those of Zeliang (1981). From his data it would appear that hatching success was approximately 70 per cent (29 chicks from 41 fertile eggs), and rearing success was about 34 per cent (10 of 29 chicks). No specific information was provided on growth rates or rates of attaining reproductive maturity, which is evidently two years.

## Evolutionary history and relationships

From a zoogeographic standpoint, this species' nearest relative should be either Temminck's tragopan or Cabot's tragopan. Thus, it exhibits the greyish bases to the feathers of the flanks and underparts that occur in Temminck's, and also has the rather yellowish facial colouration and pale buffy to rusty markings on the upper tail-coverts and mantle that

are so conspicuous on Cabot's tragopan. It thus seems to be somewhat transitional in plumage between Cabot's tragopan and the three more western forms (satyr, Temminck's and western).

## Status and conservation outlook

The status of this species is quite difficult to assess. It is considered 'rare' by the ICBP (King 1981). In that summary it was judged to be very rare in Assam (Nagaland), but could still be fairly common in five localities in extreme northern Burma. The current situation in Burma is unknown, but the species is apparently killed and trapped less frequently there than is the case in India.

In India, the nominate subspecies is now known only from the Naga Range of Nagaland (Pauna mountain on the west to Fakim, near the Burmese border, on the east), where it has recently been recorded on Pauna mountain, on Dzukou, Kipamedzu and Phekedzumi mountains, at Fakim, and in the Pulebadze sanctuary. In all these areas the total estimated population is some 400 birds (Zeliang 1981). Its status in the adjoining Patkoi range of Burma is unknown, as is also the case in the Barrail range immediately to the west in adjacent Assam. It also occurred once in the Lushai hills of extreme southern Assam (Mizoram), but there are no recent records.

The status of the more westerly race *molesworthi* is even more uncertain. It is known from only two males and a female, all taken in eastern or south-eastern Bhutan (Biswas 1968). However, the race apparently also once extended eastward through the Dafla Hills across the Brahmaputra to the Mishmi Hills of extreme north-east Assam (Arunachal Pradesh). In recent years it has been reported only from eastern Bhutan and the Dafla Hills of Arunachal Pradesh (King 1981). Cheng *et al.* (1978) list a locality record for southern Tibet, directly north of the Bhutan, Arunachal Pradesh border, and indeed Etchécopar and Hüe (1978) indicate a rather extensive range for the Blyth's tragopan in Tibet. Yet there is no good evidence that such a large Tibetan range exists, for suitable forested habitat would be extremely rare in that area. Indeed, this race is likely to be even more threatened with extinction than is the nominate form, based on the little available information.

Protection for the Blyth's tragopan in the Naga Hills, its last known area of certain occurrence, is thus vital. There is one small wildlife sanctuary present in that region, but indiscriminate killing of the birds still goes on throughout the general region (Zeliang 1981). Unless the Burmese population proves to be substantial, the total world population of the bird may well be under 1000 individuals.



## CABOT'S TRAGOPAN<sup>1</sup>

*Tragopan caboti* (Gould) 1857

Other vernacular names: yellow-bellied tragopan; tragopan de Cabot (French); Cabot-Satyrhuhn, gelbäuchige Hornhuhn (German).

### *Distribution of species*

Resident in central and north-west Fukien, northern Kwangtung, and southern Hunan, and also in north-east Guangxi Zhuang Autonomous Region of China. See map 2.

### *Distribution of subspecies*

*Tragopan caboti caboti* Gould: eastern Cabot's tragopan. Range as indicated above excepting Guangxi Zhuang Autonomous Region.

*Tragopan caboti guangxiensis* Cheng Tso-hsin: western Cabot's tragopan. Known only from north-east Guangxi Zhuang Autonomous Region (Cheng 1979).

## Measurements

Delacour (1977) reported that males (of *caboti*) have wing lengths of 210–225 mm and tail lengths of 210–215 mm, while females have wing lengths of 200–214 mm and tail lengths of 160–168 mm. Cheng *et al.* (1978) noted that six males had wing lengths of 225–233 mm and tails from 207–230 mm, while six females had wings of 192–213 mm and tails of 151–171 mm. One male weighed 1400 g., and females weigh about 900 g. The eggs average 50 × 40 mm, and their estimated fresh weight is 44.2 g.

## Description (modified from Delacour 1977)

### *Male*

Head and neck black, except the sides and tip of the crest and the sides of the neck, which are of an orange-red extending as a band around the throat; upperparts spotted black, red and pale buff, each feather having a large buff ocellus, separated by black band from red border; underparts plain pale buff; flanks, under tail-coverts and thighs marked with red and black; wings and tail mottled brown and whitish buff, the tail feathers with broad black tips. Iris brown; bill horny; bare throat pale blue; centre of lappet orange with bristly purple spots, surrounded by cobalt blue, the margins with up to nine large patches of pale greenish-grey on each side; facial skin orange-yellow, horns pale blue; legs pink to whitish.

### *Female*

Upper parts mottled black and rufous brown, with whitish triangular marks; underparts greyish brown, with large white marks; face and throat paler. Iris brown; bill and legs pinkish horn; orbital skin orange.

### *First-year male*

Like the female, but larger, with some black on the head and red on the crest and throat, some ocellus-like marks on the mantle.

### *Juvenile*

Like the female.

## Identification

### *In the field* (25–27 in.)

This species is found in dense montane forests and, like the other tragopans, is highly arboreal. Unlike the other tragopans, the male has plain buff underparts, without any ocelli, and the upperparts have only indistinct buffy spots that are flanked by black and russet, but show little development of ocelli-like markings. The courtship call of the male is apparently undescribed. Females are rufous brown above and greyish brown below, with whitish triangular or linear markings on the dorsal surface and larger whitish underpart spotting.

### *In the hand*

The uniform buffy underparts, and buffy rather than white spotting, provide for ready identification of males. Females have reddish to orange orbital skin and thus closely resemble the western tragopan, but are more buffy to whitish on the underparts, rather than greyish, and the spotting on the dorsal plumage tends to be linear to triangular rather than rounded.

## Geographic variation

The recently described subspecies *guangxiensis* differs from the nominate form in being more maroon-red on the back and rump of males, and being generally deeper maroon-red throughout, but with paler yellowish white ovoid spots near the feather tips. Females of the newly described race are much darker brown, with more black streaking throughout. The whitish spotting is also better developed in females of this race than in the nominate form (Cheng 1979).

## Ecology

### *Habitats and population density*

One of the few descriptions of the habitat of this species is by Beebe (1918–1922), who observed the birds

<sup>1</sup> Endangered species (King 1981).

in west-central Fokien. This was in heavy forest, with a dense undergrowth dripping with moisture and including azalea-like plants. The elevation was no greater than 2800 ft. However, the species has also been collected at higher elevations of 3000–4000 ft in the vicinity of Kuatun, near the Fokien–Kiangsi border. The species was apparently once common in the range of mountains separating these two provinces, but now appears to be very rare there (King 1981).

According to Cheng (1979), the race *guangxiensis* occurs at elevations of 700–1100 m, or somewhat lower than that reported for the nominate race. The birds inhabit mixed forests with heavy undergrowths of bushes, dwarf bamboos, and ferns.

#### *Competitors and predators*

This species is isolated from most of the other tragopans by a considerable distance, but according to Cheng (1979) the race *guangxiensis* is often found with the Temminck's tragopan in the forested areas of north-east Guangxi. No hybrids have been reported thus far. Nothing has been written of its possible predators.

### **General biology**

#### *Food and foraging behaviour*

La Touche (1900) stated that the crop of an immature male he examined contained young leaves, while that of a female contained acorns. Beebe (1918–1922) stated that the crop of an adult male was crammed with laurel-like leaves having a strongly aromatic odour. There were also two small land molluscs in the crop, and some grit in the gizzard. Cheng (1979) stated that birds of the newly described race *guangxiensis* feed mostly on seeds (*Castanopsis*, *Moghania*, etc.) and red beans.

In captivity this species, as other tragopans, thrives on growing or freshly cut lucerne (alfalfa), grasses, squash, cucumbers, apples, raspberries, mulberries, raisins, grapes, peanuts, and the like. Live insects are rarely fed, except to young birds, but peanuts are provided the breeding birds daily (Sivelle 1979).

#### *Movements or migrations*

Daily or seasonal movements are undescribed, but they are likely to be very small, as the mountains on which this species occur are not very high, and the seasonal changes are not likely to be severe.

#### *Daily activities and sociality*

No specific information has been recorded in the wild except that Cheng (1979) stated that the birds

would gather in small groups for foraging, and for going to water at about 10 a.m. and again about 3 p.m. In captivity the Cabot's tragopan seems to be unusually arboreal as compared with the others of its genus, and this is perhaps a reflection of the dense forests in which it lives. It is probably no more social than the other tragopans, which at most seem to occur in family units or pairs.

### **Social behaviour**

#### *Mating system and territoriality*

This is not described for wild birds. Sivelle (1979) kept a group of three males and three females in adjoining aviaries in 1979. By late March one of the males appeared to have attracted one of the hens, and the birds were allowed together. The same was tried with a second pair, but the resulting eggs were infertile, so the female was allowed to mate with the third male, which also resulted in infertile eggs. The third female, a first year bird, showed no interest in mating and never laid any eggs. These albeit artificial conditions would suggest an essentially monogamous mating system may occur.

#### *Voice and display*

The calls made by territorial male Cabot's tragopans are evidently not yet described, but probably differ but little from those described for the other species.

Virtually nothing has been written on the sexual behaviour of Cabot's tragopan in the wild, and relatively little on the species in captivity. However, Wayre (1969) has provided a fairly detailed account of the male's displays, which is here quoted:

The male Cabot's tragopan starts his display by standing in a very upright position so that his body and tail are in a vertical line; only his bill is not quite vertical. His crest is raised and the feathers round his thighs are puffed out like pantaloons. Though not extended, the blue border at the top of the lappet is strikingly visible and it is vivid cobalt-blue in colour. He then lowers the primaries of the wing nearest the hen, at the same time raising the shoulder on the opposite side, giving the appearance of flattening his body and exposing as much of his colourful plumage to the hen as possible. Still remaining very erect he circles round her.

The display may cease at this stage, or the bird may suddenly stop, facing the hen and go into the final grotesque climax, in which, with lower plumage fluffed out and wings half spread, he shakes his head and neck until his fleshy blue horns and elaborately patterned orange and blue lappet are extended to their utmost. At this moment the lappet or bib hangs down in front of the bird's breast and is spread out to display its pattern. It is all over in a matter of seconds; the horns and lappet are quickly



retracted and the bird assumes its normal shape. We have also watched a cock Cabot's tragopan stand up and whirr his wings like a silver pheasant, but in his case the wings are not vibrated so powerfully and the noise is not so loud. As with other pheasants, this display is probably in the nature of a challenge to other cocks.

Although it is assumed that only adult males perform this display, it is of interest that La Touche (1900) described the lappet of an immature male collected in March as apparently fully developed in colour. He described it as having a pink wattle, banded with pale cobalt, the bands tinged in the centre with silvery green. The 'hairy' part of the wattle was livid purple, spotted with orange vermillion. This description differs somewhat from that presented in the description of the species, and perhaps there is some age or individual variation present, as well as probable seasonal variations.

## Reproductive biology

### *Breeding season and nesting*

Apparently only a single nest of this species has been described from nature. This was found on 17 May, at Kuatan in north-west Fokien near the Fokien-Kiangsi border. It was some 30 ft above ground, in an old squirrel nest of the previous year. The nest contained four eggs, of which two were ready to hatch, and the other two were addled. The embryonic young birds already had wing quills over an inch long at this stage of development (La Touche 1900).

Beebe (1918–1922) believed that these four eggs represented two separate clutches of two each, although it is now known that in captivity clutches of three or four eggs are the usual number. Sivellev (1979) stated that his birds average three to four clutches per season, totalling 12–14 eggs.

Wayre (1969) stated that in the collection of the Pheasant Trust these birds do not always select an elevated nest site, but instead often lay their eggs in a scrape beneath the cover of an evergreen shrub. However, Sivellev (1979) reported that although about one in ten of his female tragopans (of various species) will not use one of his elevated nest boxes for laying an egg, their following clutch will invariably be in one of the boxes, which are from two to six feet above the ground. W. H. St Quintin (quoted by Beebe 1918–1922) bred this species at least twice in captivity, with the birds once laying in an old woodpigeon's nest about 10 ft from the ground, and the following year nesting in the same nest, now 14 ft above ground. A second female nested in a pigeon's nest about 8 ft up, in a spruce tree, after lining the nest with dead twigs that she broke off from neighbouring branches.

### *Incubation and brooding*

All that is known of incubation and brooding in this species comes from observations in captivity. The incubation period is 28 days, as in the other tragopans. Sivellev (1979) reported that he hatches tragopan eggs with an incubator temperature of 99.5°F and relative humidity of 84 per cent, turning the eggs three times daily. The pipped eggs are removed to a hatcher, which is maintained at 88–94 per cent relative humidity.

### *Growth and development of the young*

St Quintin (quoted by Beebe 1918–1922) reported that the chicks are hatched with a thick coating of coarse, shaggy down, and with primaries so far developed that on the first day they were able to flutter up and perch on the side of the foster mother. Their abilities at perching and climbing developed rapidly, and they would fly between their various perches as well as any young passerine bird. If left in their cage a little longer than usual at roosting time, the birds would fall asleep side by side on a perch.

Sivellev (1979) feeds his young tragopans greens and alfalfa, supplemented by commercial turkey starter feed and grains, keeping protein levels below 20 per cent, after starting them on mixed cracked grains and medicated water. After two weeks the birds are moved outside and given a variety of greens, fruits, and peanuts.

## Evolutionary history and relationships

As suggested earlier, I believe that Blyth's tragopan is this species' nearest relative, even though at the present its range is much closer to that of the Temminck's tragopan. Like Blyth's, Cabot's appears to be adapted to very moist, temperate montane forests, and presumably the ancestral area of separation of these two forms was in the mountains of southern or south-west China.

## Status and conservation outlook

This species is now considered endangered, and is believed to be very rare throughout its range, largely as a result of habitat destruction associated with agricultural activities (King 1981). The recent description of the western race *guangxiensis* extends the species' known range somewhat, and provides additional hopes for the birds' survival.

All of the current captive stock are derived from birds sent out of China since 1960, when five males and two females were received by the Pheasant Trust. All told, about 15 birds were imported over



about a 10-year period, and quite a number of young were raised. In 1978 and 1979 the Trust sold their stock to various private breeders, including Mr. C. Sivel in the U.S., who has had considerable success with breeding them (Sivelle 1979).

Several nature reserves have recently been estab-

lished by the Chinese within the historic range of this species, the largest of which is a 5000 ha reserve (Luyuan Wuzhishan Chingjendong) in Kwangtung Province (Wang 1980). At least three other smaller reserves also occur within the possible range of this species.

## 4 · Genus *Pucrasia* G. R. Gray 1841

The koklass is a medium-sized montane pheasant in which the sexes are moderately dimorphic; males have a well-developed occipital crest and lateral erectile feather tufts, but females have a shorter crest and lack the tufts. In both sexes the head is entirely feathered and many of the body feathers are lanceolate. The wing is somewhat rounded, with the tenth primary considerably shorter than the ninth, and the seventh primary slightly the longest. The tail is highly graduated, and of 16 feathers, the middle pair of rectrices are about twice as long as the outermost pair. The upper tail-coverts are greatly elongated and almost as long as the tail. The tarsus is longer than the middle toe and claw, and is spurred in males. A single species is recognized.

### KEY TO SUBSPECIES OF MALES OF *PUCRASIA MACROLOPHA* (in part after Delacour 1977)

- A. Mantle feathers with single black shaft-streaks.
  - B. Sides and flanks mostly grey.
    - C. Chestnut collar present on hindneck: Kashmir koklass (*biddulphi*).
    - CC. No distinct collar, although sides and red of neck sometimes buffy yellow.
      - D. Brighter and paler throughout: Indian koklass (*macrolopha*).
      - DD. Duller and darker throughout: Punjab koklass (*bethelae*).
  - BB. Sides and flanks mostly black or chestnut.
    - C. Sides and flanks black, edged with grey: Nepal koklass (*nepalensis*).
    - CC. Sides and flanks chestnut: western koklass (*castanea*).
- AA. Mantle feathers with two or more black streaks.
  - B. Mantle feathers with four black streaks, separated by three white wedges: Darwin's koklass (*darwini*).
  - BB. Mantle feathers with two black streaks, separated by a white wedge.
    - C. No distinct nuchal collar present: Joret's koklass (*joretiana*).
    - CC. A distinct yellowish nuchal collar present.
      - D. Nuchal collar orange: orange-collared koklass (*ruficollis*).
      - DD. Nuchal collar yellow.
        - E. Basal portions of outer rectrices mostly grey: yellow-necked koklass (*xanthospila*).
        - EE. Basal portions of outer rectrices mostly yellow: Meyer's koklass (*meyeri*).

### KOKLASS

*Pucrasia macrolopha* (Lesson) 1829

Other vernacular names: None in general English use; eulophe macrolophe (French); Koklas-fasan (German).

### Distribution of species

Discontinuous, from eastern Afghanistan eastward through the Himalayas, normally from about 6000 to 12 000 ft, to west-central Nepal; again from eastern Tibet and north-west Yunnan north-eastward through the mountains of western China to south-west Manchuria; and again in the mountains of eastern and south-east China from Hupeh and Anhwei south to northern Kwangtung. Sedentary, but moves altitudinally with the season. Occurs in steep, broken, or rocky mountain slopes in coniferous or mixed forests, or in sites grown with dense brush and bamboos (Vaurie 1965). See map 3.

*Distribution of subspecies* (after Vaurie 1965; Wayre 1969; Ripley 1961)

*Pucrasia macrolopha macrolopha* (Lesson): Indian koklass. Resident in Lahul and north-east Jammu north of the range of Goddulphi from 6000 to 14 000 ft; in dry temperature forest.

*Pucrasia macrolopha castanea* Gould: western koklass. Resident in the mountains of Nuristan in eastern Afghanistan to Chitral in Pakistan, at 7000 ft.

*Pucrasia macrolopha biddulphi* Marshall: Kashmir koklass. Resident from Gilgit and Kashmir eastward to Ladakh and to Kulu in northern Punjab, where it intergrades with the nominate race *macrolopha*. From 6500–11 000 ft. The birds of Kulu (*bethelae* Fleming 1947) occur between the population of Kashmir and that of Garhwal farther to the east, and appear to be a clinal form.

*Pucrasia macrolopha nipalensis* Gould: Nepal koklass. Resident in western Nepal, east to about long. 83° 40' E, above 6000 ft.

*Pucrasia macrolopha meyeri* Madarasz: Meyer's koklass. Resident in western and south-west Szechwan (regions of Bateng and Baurang) to north-west Yunnan to the Likiang Range and Shweli–Salween Divide.



**Map 3.** Distribution of Darwin's (D), Indian (I), Joret's (J), Kashmir (K), Meyer's (M), Nepal (N), orange-collared (O), western (W), and yellow-necked (Y) races of koklass.

*Pucrasia macrolopha ruficollis* David and Oustalet: orange-collared koklass. Mountains of western Szechwan, north to southern Kansu and Shensi, possibly intergrading with *xanthospila* in the north.

*Pucrasia macrolopha xanthospila* G. R. Gray: yellow-necked koklass. Resident in northern Shensi and the mountains of Inner Mongolia, north-east to the mountains of western Hopeh and south-west Manchuria.

*Pucrasia macrolopha joretiana* Heude: Joret's koklass. Resident in the mountains of south-west Anhwei; between 2000 and 5000 ft.

*Pucrasia macrolopha darwini* Swinhoe: Darwin's koklass. Resident in the mountains near Itchang (Hupeh), south-west Szechwan, Chekiang, Fukien, and northern Kwangtung.

### Measurements

Delacour (1977) reported that *macrolopha* males have wing lengths of 580–640 mm, while females have wing lengths of 180–218 mm and tail lengths of

172–195 mm. Ali and Ripley (1978) report *castanea* male wing lengths of 240–252 mm, and tail lengths of 178–252 mm. A female had a wing of 228 mm. Males of *biddulphi* had reported wing lengths of 233–249 mm. Males of *macrolopha* were reported to weight from 2½ lb to 3 lb 2 oz (c. 1135–1415 g), and females from 2¼ to 2½ lb (c. 1025–1135 g). Cheng *et al.* (1978) reported an average weight for 10 males of 1184 g, and for 10 females of 932 g. They also reported average male wing and tail lengths (all subspecies) of 212.4 mm. and 206.8 mm respectively, and average female wing and tail lengths of 196.7 and 148.8 mm respectively (10 specimens of each sex). The eggs average 51 × 37.5 mm, and estimated fresh weight 40 g.

### Description (after Baker 1928)

#### *Adult male (of macrolopha)*

Crown chestnut-fawn; lateral tufts and whole head black glossed with green; a large patch of white on



the sides of the neck; whole upper plumage silver-grey, a lanceolate streak down the centre of each feather velvety-black, the shafts on the lower back and rump paler; upper tail-coverts more chestnut, the longest almost entirely chestnut with grey tips and with longitudinal broken lines of black; central tail feathers rufous, tipped grey, black-shafted, a well-defined black line and a second, less well-defined line running parallel with the shaft; wing-coverts like the back; the grey edges replaced by rufous-brown, shading into grey; flight feathers brown with broad edges of buff, the innermost secondaries mottled and blotched with velvety-black; foreneck to vent deep bright chestnut, varying considerably in depth and extent but generally covering the greater part of the chest and abdomen; sides of the neck, breast and lower flanks grey, each feather with a central streak of black and those next the breast with the outer web chestnut; under tail-coverts tipped with white spots; vent pale chestnut, the feathers with black bases; thighs dull buff mottled with chestnut. Iris dark brown; bill horny-brown to black, less often plumbeous-horny or brown, tinged with greenish or purplish to fleshy or livid brown.

#### *Female*

Crown chestnut or buff with broad black crescentic bars, decreasing on the short paler crest; buff or creamy supercilia, broad and ill-defined; upperparts pale brown with numerous fine broken bars of blackish, pale buff stripes and centres; the upper back and shorter tail-coverts richer in colour and more boldly marked than the rest; longest tail-coverts not blotched, but with pale edges and fine vermiculations of dark brown; central tail feathers rufous buff, pale tipped with irregular bars of black centred with chestnut; outermost feathers chestnut with white tips, black subterminal bands, and black mottling on either web, intermediate feathers the same but with less black on each succeeding pair; chin and throat creamy-buff, with a line of black spots from the gonys; foreneck and hindneck buff with broad black or brown edges to each feather; remainder of lower plumage pale buff to creamy-rufous, with dark brown streaks, narrowest on the breast, broadest on the posterior flanks; vent and centre of abdomen whitish with brown spots; under tail-coverts chestnut with white spots. Iris brown, legs grey, bill horny brown (Delacour 1977).

#### *Immature*

Closely resembles the adult female (Delacour 1977). Young males assume their adult plumage during the first year.

#### *Juvenile*

The first breast feathers are a pale buff with two black spots near the tip of both webs on a grizzled background; the wing-coverts are also grizzled buff, with white tips and two subterminal black patches (Delacour 1977).

#### **Identification**

##### *In the field* (21–24 in.)

This is a medium-sized pheasant associated with montane woodlands, including both hardwood and coniferous forests. The chestnut breast, black head, and white patches on the sides of the neck are unique, and the female also has a distinctive whitish patch along the side of the neck. Both sexes have somewhat elongated blackish to brownish tails, with paler tips, and tapering occipital crests that in the male are sometimes raised into ear-like display structures. The male's call in spring and summer is a loud *pok-pok-pok . . . pokras*, uttered mainly during morning and evening hours.

##### *In the hand*

In both sexes the white to creamy white neck markings, and a somewhat elongated tail (170–300 mm) with a paler tip, are distinctive. In both sexes the flank feathers are rather lanceolate, with dark brown centres and buffy edges, and iridescence is limited to the dark greenish black head of the male.

#### **Geographic variation**

Geographic variation in this widely distributed species is very great, and tends to be clinal in some respects. There are three groups of subspecies that apparently are completely isolated from one another. The westernmost or nominate group extends from *castanea* on the western edge of the species' range through *nipalensis* in central Nepal. The second (*xanthospila*) group consists of several widely dispersed and possibly isolated races, from *meyeri* in eastern Tibet to *xanthospila* in northern China. The third (*darwini*) group of eastern China consists of only two races, the widely distributed *darwini* and the localized *joretiana*.

Much of the plumage variation in these groups involves male upperpart plumage colour and tail patterning. In the westernmost or *macrolopha* group the feathers of the upperparts, breast and flanks have uniformly black areas along their shafts, and those of the hindneck are dark chestnut to silvery grey, sometimes tinged with buff. In the intermediate (*xanthospila*) group the hindneck is golden yellow, which extends laterally around the sides of the neck

to form an incomplete collar, and the feathers of the upperparts have grey shaft-streaks that divide the black area of each feather into two components. In the third (*darwini*) group the males lack the distinct golden collar, and the feathers of the upperparts have four rather than two lateral black streaks. Additionally the lateral tail feathers vary from more or less chestnut-coloured in the *macrolopha* group (and *meyeri* of the *xanthospila* group) to patterned black and silvery grey in the remaining subspecies. This same plumage variation in the tail feathers also exists in females, which otherwise tend to be quite similar throughout the species' range (Vaurie 1965).

## Ecology

### *Habitats and population densities*

In Himachal Pradesh the koklass has a relatively wide ecological distribution, reaching from the lower altitude oak forests to the alpine meadow or scrub zone, but being most commonly observed in the higher altitude oak and coniferous forests, and fairly widely occurring through the several temperate forest types. It seems to be most common where the undercover is well developed. It occurs only sporadically below 2000 m, but it shows a seasonal shift to the lower altitude coniferous forests between December and March, and back to the higher altitude oak forests in April and May (Gaston *et al.* 1981). In Kashmir the birds are widely distributed, occurring from about 6000 ft up to the limits of the pines, but probably are most common above 7000 ft. They seem to be particularly associated with broken ground having good cover, and avoid more open slopes and flats (Bates and Lowther 1952). In Himachal Pradesh over 50 per cent of the records made by Gaston *et al.* (1981) were in habitats having more than 70 per cent ground cover. Baker (1930) stated that the birds are partial to forest of cypress, paludna and other pines, and prefer broken ground to other topographic sites. Wherever they occur, they are always found where there is a good deal of undergrowth such as ringal bamboo as well as trees.

Elsewhere farther east the ecological distribution is well known, but Schäfer (1934) indicated a rather restricted vertical range in China for *meyeri* in the transition zone between agricultural lands and montane forests, at an altitude of somewhat above 3000 m (10 000 ft). Cheng (1963) stated that in China the birds occur between 2000 and 4000 m in pine forests located on rocky slopes of tall mountains. The Nepal race *nepalensis* also occurs between about 8000 and 11 000 ft, mainly in oak, conifer, and bamboo forests of western Nepal, west of the Kali Gandaki River (Roberts 1981).

Because of its regular morning calling behaviour, censusing of the koklass can be done fairly easily. In Pakistan, for example, the density in favourable habitats such as the Murree Hills is more than five pairs per square mile (1.9 km<sup>2</sup>; Mirza 1981a). Severinghaus (1979) estimated that in one study area of Pakistan there were 11 males in an area of 120 acres, resulting in an estimated density of 9.2 males (or pairs) per 100 acres (40 ha), or about 59 pairs per square mile (23 per km<sup>2</sup>). He cited a variety of earlier studies suggesting densities ranging from four to 26.9 pairs per square mile.

In Himachal Pradesh a density of 17–25 pairs per km<sup>2</sup> (6.5–9.6 per square mile) has been estimated in the Simla area, and many forest reserve areas support densities of at least five pairs per km<sup>2</sup> (Gaston *et al.* 1981).

### *Competitors and predators*

This species is highly herbivorous, and although it occurs in much the same habitats as the monal the two species forage in very different ways and almost certainly do not seriously compete with one another.

Presumably the usual array of Himalayan predators affect the koklass, and Baker cites an observation by C. Whympere in which he observed a female koklass hit in full flight by a crested eagle (*Spizaetus nepalensis*). Whympere ran up and caught the downed bird, which he was able to release later on.

## General biology

### *Foods and foraging behaviour*

Baker (1930) stated that this species feeds on all kinds of grain, grass seeds, acorns, berries and buds, and also upon insects and worms, although he believed it is probably much more vegetarian than insectivorous. He mentioned that one bird that had been examined had been eating almost nothing but coarse grass, with a little maidenhair fern and moss. Cheng (1963) reported that two birds collected in China had eaten ferns (*Selaginella*), maize, the seeds and fruits of solanaceous plants, and the seeds and tender needles of pines, spruce, and other plants.

Observations in captivity confirm the fact that this is a highly herbivorous species, eating large amounts of green food, particularly grass and lucerne (Howman 1979).

### *Movements or migrations*

At least in Himachal Pradesh there is a seasonal movement downward of approximately 1000 m, so that by February the birds are concentrated at about 2200–2500 m. In most locations where koklass were



observed by Gaston *et al.* (1981) there were some areas of suitable habitat extending below 2500 m, suggesting the importance of snow-free winter habitat. In Nepal, the amount of snowfall is much less in the east than in the western Himalayas, and so the birds may not have to descend so low in winter (Roberts 1981).

#### *Daily activities and sociality*

This species apparently keeps very close to the same quarters, and may be found morning after morning and evening after evening in the same open glades searching for food. The birds are monogamous, and apparently remain in pairs throughout much of the year. Gaston (1981a) says that the birds are usually solitary or at most in pairs.

Roosting is done in trees, and Severinghaus (1979) reported that one such roost that he observed consisted of pines, with the roost sites 6–9 m high. These pines were on a south-facing slope, and were about 30–35 years old, with few shrubs or herbs directly below them. The Chinese name for this species, 'Sung chi', meaning pine chicken, apparently refers to the tendency of the koklass to roost in pines and to consume its needles (Cheng 1963).

### Social behaviour

#### *Mating system and territoriality*

Baker (1930) stated that it is 'almost certain' that these birds are monogamous, and that the male may be found in the close vicinity when the female is incubating. Further, once the chicks have hatched the male participates in brood-rearing and brood protection. Later writers have generally confirmed the view that an extended monogamous mating system prevails in this species.

Territoriality is well developed in the koklass, judging from the high level of male calling typical of the species. Gaston (1981a) indicated that the calling season lasts from at least November through to May, or longer than any other Himalayan pheasant species he listed except for the cheer. In January, the peak of male calling lasts about 15 min each morning, with a maximum of calling at intervals of about two calls per minute, gradually tapering off to about one call per minute. Severinghaus (1979) found that calling begins about 30–45 min before sunrise, and is greatest during the first 20–30 min, declining thereafter. Calling in the late afternoon is less frequent than during early morning.

Territorial sizes have not been directly estimated, but Lelliott and Yonzon (1981) noted that 11 male koklass were heard calling in a 1.2 km<sup>2</sup> study area in May, suggesting a maximum territorial size of about 10 ha, or some 25 acres. As noted earlier, in some

areas the density may even reach more than 20 pairs per km<sup>2</sup>, requiring territories of about half this size.

#### *Voice and display*

The male's territorial call is a distinctive *kok-kok-kok-... kokras*, or sometimes given as *khwa-ka-kak*. Severinghaus (1979) has listed some 14 phonetic renderings of this call, and concluded that there may be major geographic variations in its sound, at least in different subspecies. The call is uttered mainly during morning and evening hours, but also throughout the day in cloudy weather. Frequently several males will respond simultaneously to the sound of a gun or thunder (Ali and Ripley 1978).

Besides this call, Severinghaus (1979) has described several additional call types, all of which seem to be variants of the usual crowing call. However, they differ in numbers of syllables, relative emphasis of the individual syllables, timing of the syllables, total call duration, and the duration of individual syllables.

More recently, Lelliott (1981b) has studied the vocalizations of the koklass, and described a total of five different calls. The first is a harsh, rapid and staccato *kuk-kuk-kuk-kuk...* uttered during flushing in alarm. A second call is a repeated *aw-cuk* note, which is produced by both sexes and may be uttered for as long as 15 min, often when the bird is confronted by an unfamiliar object. A third note, not heard by Lelliott, is a rather melodious clucking and six-syllable call *chuk-cher-ra-ka-pa-tcha*, associated with frontal threat display by males.

The fourth call noted by Lelliott is the familiar crowing call of males, which occurs in many variant forms, as Severinghaus has previously noted. However, Lelliott noted that in spite of all these variations individual birds cannot be recognized on the basis of general call type, as males often shift their call types in the course of a morning's calling activity. Lelliott noted that the call-type used in his area of study (*nipalensis*) differed from that reported as most common by Severinghaus for *castanea*. However, certain individuals could be recognized by their distinctive calling patterns by Lelliott. He judged that the function of the crowing call is uncertain but probably territorial, inasmuch as tape-recordings tended to cause males to approach the tape recorder or at least to answer the crow with calling of their own.

The last call-type noted by Lelliott consisted of a soft female call uttered in response to male crowing, which he described as a soft *oowow* or *kerwakow*. He judged that it might serve as a contact note, informing the male that she was close by. Lelliott did not observe any courtship display in his study, and believed that the general assumption that the



species is monogamous is probably correct. He noted that the birds are highly solitary, even after the breeding season, and also found them to be extremely shy and difficult to observe.

Displays of the koklass has been described by Wayre (1964) and by Harrison and Wayre (1969). This display is performed relatively quietly. In situations of threat the male typically faces the threatening individual, with the ear-tufts held flat, and plumage sleek, the neck and head extended forward to the level of the body, and the tail slightly cocked. This posture is accompanied by threatening lunges and a continually repeated, subdued, and somewhat melodious chuckling call, *chu-cher-ra-ka-pat-tcha*.

A second posture, oriented laterally, is in some ways the antithesis to the forward threat. The stance is relatively erect, with the bird at right angles to and sometimes leaning away slightly from the focus of its attention. The ear-tufts are erected vertically like rabbit-ears, and the white cheek patches are fluffed up, especially toward their lower edges (Fig. 16). The neck feathers are also fluffed, making the neck appear short and thick, and the body is held in a slanting manner so as to expose the maximum of plumage toward the other individual. The plumage, including the upper tail-coverts, is ruffled, as are the flank and belly feathers, while the wing on the displayed side is drooped slightly. The tail is spread fan-like, and is twisted sufficiently strongly toward the target of the display that it follows the same plane of the body-slant. In this posture the male circles around its partner, sometimes making a sudden run of a few yards in intense lateral display, with the farther wing strongly drooped and the primaries scraping along the ground, producing a rustling sound. This display is otherwise relatively silent, although the male may also assume an upright posture and utter the typical loud crowing call. When the female is the object of this attention she may remain indifferent, or stand still, with her neck stretched parallel to the ground and with her cheek feathers and short ear-tufts erected. Or, she may suddenly crouch, and the male will then immediately mount her.

## Reproductive biology

### *Breeding season and nesting*

In various parts of India the koklass breeds from April to June (Ali and Ripley 1978). In Kashmir, nests with eggs have been found as late as 15 July (Bates and Lowther 1952), but probably over most of the country earlier nesting is typical. Baker (1930) says that the nominate race begins laying about the end of April, and continues on well into June. Evi-



Fig. 16. Postures of male koklass, including normal (A) and erect pinnae (B), and waltzing from farther (C) and nearer (D) sides. After photographs of live birds.

dently most birds lay from the middle of May to about the end of June in this race. Most nests are placed under thick bushes, usually of evergreens, on the sides of hills in coniferous forests. The nest is sometimes hidden among bracken, but may also be placed in tangles of briars, raspberries, or other canes, and is invariably well hidden from view. Sometimes the nest is wedged amongst the roots of a tree, and in such cases may be in a hole or hollow virtually out of sight. The presence of thick undergrowth and perhaps a proximity to water appear to be the major requisites for nesting in this species, according to Baker.

The normal clutch is probably five to seven, with Baker recording one clutch of nine. Clutches of eight have also been recorded. Yet these large clutch sizes are unusual, and sometimes full clutches of only four eggs have also been found. Most probably six is the commonest clutch size, judging from records in the wild, although Howman (1979) suggests that nine to twelve are typical in captivity.

#### *Incubation and brooding*

Incubation is performed by the female, with the male apparently remaining close at hand, and takes 26–27 days. The young are highly precocial, and are able to fly well within only a very few days (Baker 1930).

#### *Growth and development of the young*

There is no specific information on growth rates and periods of dependency of the young. Maturity occurs during the first year, and probably young males become territorial the spring following hatching. Young birds raised in captivity may be fed the usual pheasant diet, but probably should be shifted to a diet of greens as early as possible. They are also highly sensitive to infections, and thus sometimes are best kept on wire netting frames off the ground, provided that access to green foods can be maintained (Delacour 1977).

#### **Evolutionary history and relationships**

The genus *Pucrasia* is apparently relatively isolated, and has no close relatives. Delacour placed it

between *Tragopan* and *Lophophorus*, mainly because of known hybrids with these two genera as well as with *Catreus*. However, he noted that the lanceolate plumage of the males is similar to that of *Ithaginis*, and similarities in social displays and mating systems between these two genera have previously been noted. The downy young are distinctively ruffed in the occipital region, but Delacour (1977) states that they resemble those of tragopans in shape and behaviour. I believe that the genus is fairly close to the partridge group, and thus probably should for the present be maintained in the relative linear position accorded it by Delacour, namely close to *Ithaginis* and the tragopans.

#### **Status and conservation outlook**

Over most of its Himalayan range at least this species seems to be fairly secure, although it is vulnerable to destruction of mature middle-altitude forests with thick undergrowth, its prime habitat (Gaston 1981a). In Pakistan its population is still quite favourable, but overgrazing and agricultural encroaching do pose some threats (Mirza 1981a). The species is not highly prized for its plumage, and it is apparently less prone to being trapped than are some of the other pheasants of the area. It is considered as very secretive and ultra-wary by Yonzon and Lelliott (1981), and thus its mortality rate as a direct result of human activities is still fairly low.

# 5 · Genus *Lophophorus* Temminck 1813

The monals are large montane pheasants in which the sexes are highly dimorphic, and iridescent plumage is extensive in males excepting the underparts, which are velvety black. Males also have bare, bright blue orbital skin and crests of varying size and shape. The bill is long and highly curved, with the upper mandible strongly overlapping the lower one. The wing is rounded, with the tenth primary being the shortest, and the fifth and sixth the longest. The tail is flat, broad, and shorter than the wing, and has 18 rectrices. The tarsus is stout and shorter than the middle toe, and is spurred in males. The tail moult is phasianine (centripetal). First-year males resemble the females, which are dark brown, with rufous and whitish markings. Three species are recognized.

## KEY TO SPECIES (AND SUBSPECIES OF MALES) OF *LOPHOPHORUS*

- A. Upperparts mostly iridescent (males).
  - B. Tail bluish green: Chinese monal.
  - BB. Tail mostly chestnut and less than 250 mm in length.
    - C. Tail entirely chestnut, crest feathers with naked shafts: Himalayan monal.
    - CC. Tail white and chestnut, crest feathers short and curly: Sclater's monal.
    - D. White tail-band 20–28 mm wide: western Sclater's monal (*sclateri*).
    - DD. White tail-band 10–20 mm wide: eastern Sclater's monal (*orientalis*).
- AA. Upperparts brownish and non-iridescent (females).
  - B. Lower back pure white; wing at least 315 mm: Chinese monal.
  - BB. Lower back barred with black or brown; wing under 300 mm.
    - C. Crested; underparts coarsely marked, and lower back barred with buff and black: Himalayan monal.
    - CC. Uncrested; underparts finely speckled, and lower back barred with brown and white: Sclater's monal.

## HIMALAYAN MONAL

*Lophophorus impeyanus* (Latham) 1790

Other vernacular names: impeyan pheasant; monaul; moonal (from central Himalayan vernacular); lophophore resplendissant (French); Himalaya Glanzfasan, Königs-Glansfasan (German).

## *Distribution of species*

Eastern Afghanistan (Nuristan and Safed Koh), and Pakistan's North West Frontier Province, eastward through the Himalayas to Bhutan and north-east Assam (Mishmi Hills), and neighbouring southern Tibet to area east of Lhasa (Pome and southern Chamdo to the valleys of the Po Yigrong and Brahmaputra, to at least the region of Showa Dzong, or to about long. 95° 30' E). Also reported from Burma (Yin 1970). Breeds from 9000 to 12 000 ft in the Himalayas, but it has been reported at 15 000 ft and found breeding at 8000 ft in Garhwal and 7000 ft in Kashmir. Sedentary, but slight altitudinal movements have been reported. Occurs in relatively open coniferous, mixed, or deciduous forests and rhododendrons, usually on rocky, broken, and precipitous slopes and in gorges (Vaurie 1965). See map 4.

## *Distribution of subspecies*

None recognized by Delacour (1977), although females from eastern areas are said to be more rufous and richer in tone.

## Measurements

Ali and Ripley (1978) report male wing lengths of 289–320 mm and tail lengths of 215–235 mm, while female wing lengths were reported as 259–287 mm. Delacour (1977) reported a female tail length of 200 mm, and Ali (1962) indicated a female tail length of 189 mm. Three females measured by me had tail lengths of 182–189 mm. The weight of males ranges from 4 lb 6oz to 5¼ lb (c. 1980–2380 g), while females range from 5¼ lb to 4¾ lb (c. 1800–2150 g). Lack (1968) reported the average adult weight as 2000 g. The eggs average 63.5 × 44.9 mm, and the estimated fresh weight is 70.7 g.

## Description (after Baker, 1928)

### *Adult male*

Head and long crest of spatulate feathers metallic green; a patch of deep metallic purple behind the ear-coverts; lores and a streak behind the eye nearly bare; sides of neck and nape fiery copper-bronze changing gradually into bronze-green on the back;





**Plate 1.** Himalayan blood pheasant, pair. Painting by H. Jones.



**Plate 2.** Geoffroy's blood pheasant, pair. Painting by H. Jones.



**Plate 3.** Western tragopan, pair. Painting by H. Jones.



**Plate 4.** Satyr tragopan, pair. Painting by H. Jones.





Plate 5. Temminck's tragopan, pair. Painting by H. Jones.



Plate 6. Blyth's tragopan, pair. Painting by H. Jones.





Plate 7. Cabot's tragopan, pair. Painting by H. Jones.



Plate 8. Kashmir koklass, pair. Painting by H. Jones.



Plate 9. Darwin's koklass, pair. Painting by H. Jones.



Plate 10. Himalayan monal, adults. Painting by H. Jones.





Plate 11. Chinese monal, pair. Painting by H. Jones.



Plate 12. Sclater's monal, pair. Painting by H. Jones.





Plate 21. Black-breasted kalij, pair. Painting by H. Jones.



Plate 22. Lineated kalij, pair. Painting by H. Jones.





**Plate 23.** True silver pheasant, pair. Painting by H. Jones.



**Plate 24.** Edwards' pheasant, pair. Painting by H. Jones.



Plate 25. Swinhoe's pheasant, pair. Painting by H. Jones.



Plate 26. Salvadori's pheasant, pair. Painting by H. Jones.





**Plate 27.** Crestless fireback, pair. Painting by H. Jones.



**Plate 28.** Vieillot's crested fireback, pair. Painting by H. Jones.



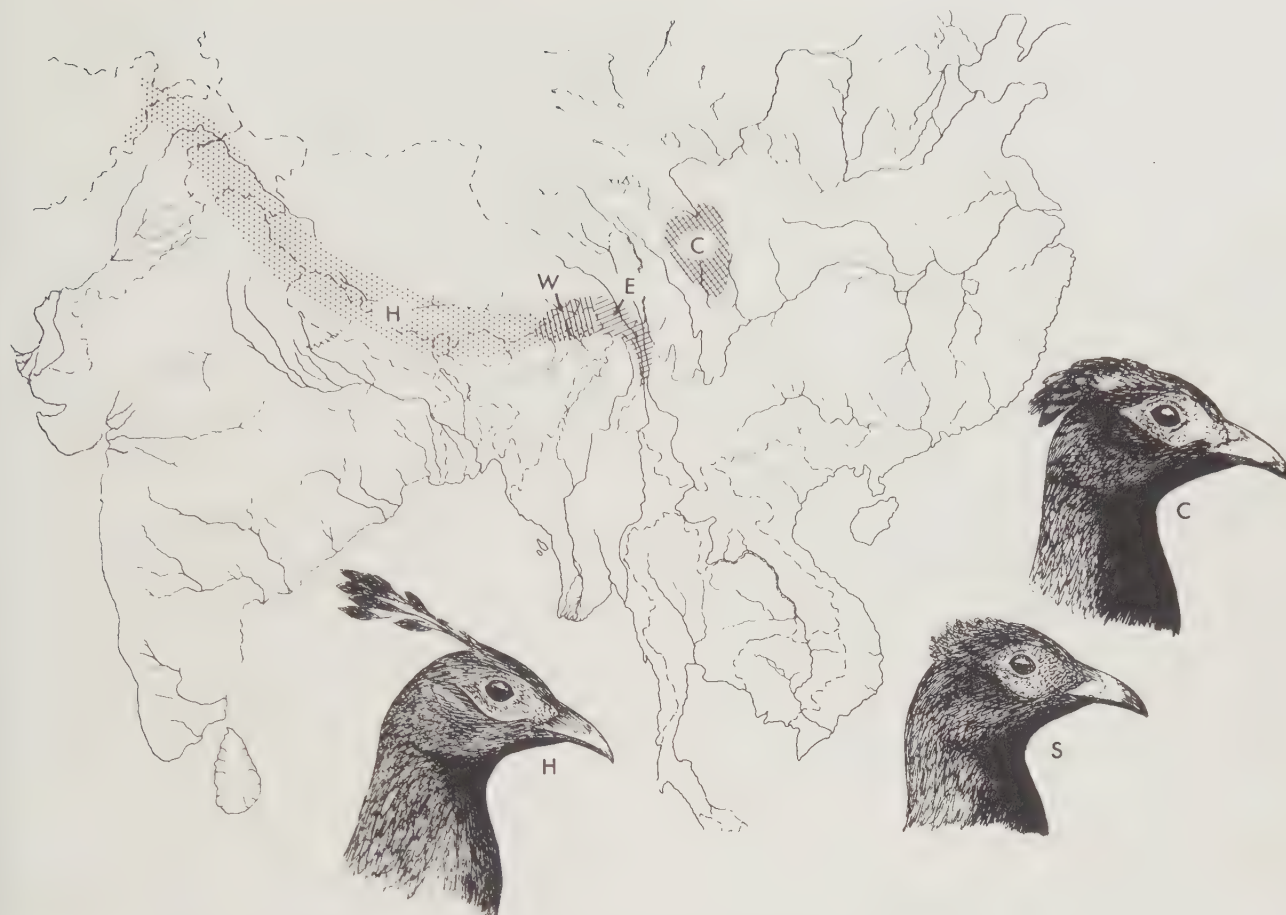
Plate 29. Imperial pheasant, pair. Painting by T. Greenwood.





Plate 30. Wattled pheasant, pair. Painting by H. Jones.





**Map 4.** Distribution of monals, including Chinese (C), Himalayan (H), and Sclater's (S), the last including eastern (E) and western (W) races.

scapulars and adjacent wing-coverts, innermost secondaries and rump purple, the secondaries tipped metallic green-blue; lower back white, sometimes with fine black shaft-stripes; rump and shorter tail-coverts purple, more or less glossed with blue-green; longest tail-coverts metallic green; tail cinnamon, darker at the tip; shoulder of wing and remaining coverts metallic green; primaries and secondaries dark brown, the latter glossed with green on their margins; underparts brownish black or dull black, glossed with green on the breast and flanks, under tail-coverts metallic green with dark bases. Iris brown; orbital skin and cheeks bright blue or smalt-blue; bill horny brown, paler and yellowish on the culmen, tip and commissure; legs yellowish or pale brownish green, sometimes darker and, rarely, lead-grey. The colours of all these parts vary greatly.

#### *Female*

Feathers of head and short lanceolate crest black with central streaks and edges of rufous buff; nape the same with broader streaks; back and mantle

black, with two buff streaks and buff edges to each feather; here and there the buff is replaced with white, giving a curious mottled appearance; lower back buff with crescentic black bars; tail-coverts buff with larger bars occupying most of the feathers; longest tail-coverts with white; visible parts of wing-coverts and secondaries like the back but more mottled; primaries and outer secondaries dark brown, the former mottled, the latter barred with rufous buff on the outer webs; chin, throat and fore-neck white; remainder of lower parts brown, the breast and flanks with dark lines, these more broken and fewer on the abdomen and lower breast, their place being taken by pale central streaks and white shafts; lower tail-coverts white, barred with black and rufous. Iris dark brown, bill pale horn with a darker upper mandible, the legs and toes pale yellowish but variable (Delacour 1977).

#### *First-year male*

Resembling the adult female but larger, with some black spots on the throat and occasionally a few iri-

descent feathers on the upperparts (Delacour 1977). Adult plumage is attained in the second year.

#### *Juvenile*

Like the female, but less distinctly marked (Delacour 1977).

### Identification

#### *In the field (22–25 in.)*

This montane species is found on steep slopes, especially where the ground is greatly broken and where there are occasional grassy areas interspersed with woods. In flight the white rump of the male is conspicuous, and the blackish underparts are also distinctive. The male's tail is entirely chestnut, and there is also chestnut present on the wings. The female is mostly a rich chestnut brown, with a rather short, squarish tail and buffy body streaking, and a bluish area of skin around the eye. Unlike the similar Sclater's monal, the female also has an erectile crest and a narrower white tail-band. The usual call is a wild, ringing whistle, which is often used as an alarm note, and is similar to that of a curlew (*Numenius*). A *chuck-chuck* call is also used by disturbed birds.

#### *In the hand*

The long, decurved bill and the flat, fairly short tail (under 250 mm) identifies this as a monal. In males, the entirely chestnut tail and narrow, erect plume feathers are unique, while in females the short crest (of about 25mm) and near-absence of a white tail-band separates the species from the similar Sclater's monal, while the absence of white on the lower back and its smaller size separates it from the Chinese monal.

### Ecology

#### *Habitats and population densities*

In Pakistan this species occurs between 8000 and 12 000 ft, generally occurring as elsewhere in the Himalayas in rocky crags near tree line, but also in various valleys including those having birch trees (Mirza 1981a).

In Himachal Pradesh the birds occur between 3000 and 3800 m, mainly in low forests and scrub close to the tree line, but descending to as low as 2400 m in winter, and then found in dense forests that have good undergrowth and usually on fairly steep slopes (Gaston 1981a). Monals have been recorded in a variety of habitat types, but especially occur in higher altitude oak forests of Himachal Pradesh, especially during spring and autumn. In the

winter months they are more generally distributed through various forest types, including those dominated by pines and firs (Gaston *et al.* 1981). The birds move up into subalpine meadow areas in September and October, and a minority of the records obtained by Gaston *et al.* (1981) were in habitats with at least 70 per cent ground cover. The largest number of observations occur in relatively dense canopy cover (over 50 per cent), and shrub cover ranging from 0 to 90 per cent.

In Nepal the species occurs on open rocky grass-covered slopes and in the adjacent birch and rhododendron forests, mainly between about 3000 and 4100 m. In one such area about eight pairs per kilometre of ridge were estimated to be present (Yonzon and Lelliott 1981).

Other population density estimates are few, but in some areas of Pakistan the density may be about five pairs per square mile (1.9 km<sup>2</sup>) according to Mirza (1981a). Gaston *et al.* (1981) censused a variety of habitats in Himachal Pradesh, and found densities as high as four to eight males in areas of 1 km<sup>2</sup> or less. However, for larger areas the densities were much lower, on the order of about 2.5 to seven pairs per km<sup>2</sup>.

#### *Competitors and predators*

The unique foraging method of this species probably places it well out of competition with other genera of pheasants, as well as other birds of similar size.

Baker (1930) judged that most of the 'troubles' of this species come from eagles since he observed that the birds seemed to repeatedly gaze up into the sky while they were foraging in exposed areas. No doubt various predatory mammals also affect the monal as well, but specific information is lacking. Beebe (1918–1922) found the carcass of a male that had apparently been killed by 'some great bird of prey', and close by saw a golden eagle that he believed had been responsible for the kill.

### General biology

#### *Food and foraging behaviour*

Beebe (1918–1922) has summarized the foods of this species well. He suggests that terrestrial insects and tubers form its chief foods, but the specific foods vary greatly by locality. Wherever snow does not cover the ground the birds spend a great deal of time digging with their beaks, apparently for tubers, roots, and subterranean insects. In autumn it is said to forage largely on insect larvae that it finds under decaying leaves, and at other times of the year on roots, leaves and young shoots of various shrubs and grasses, as well as acorns, seeds and berries.



Although in winter it may be seen in wheat and barley fields it seeks roots and maggots rather than the grain. Edible mushrooms, wild strawberries, currants, and the roots of ferns have also been mentioned as local foods. Beebe noted that the crops of the birds he examined were filled with hard tuber fragments, and he judged that the sharp edges of the bird's mandible were important in cutting and splitting plant tissues of such firm consistency as these.

The foraging behaviour of the monal is very distinctive. The birds do very little digging with their feet, but instead pick at the earth with their shovel-like beaks, sometimes digging holes as deep as a foot. When a large tuft of grass or bamboo is encountered the birds will dig around it until it is left supported only by its bare roots, or it may actually be toppled over. The birds typically forage in small groups, but do not usually fight over foods that are excavated in this manner (Baker 1930).

#### *Movements and migrations*

Gaston *et al.* (1981) noted that this species seemed to exhibit the greatest altitudinal movements of the pheasants they observed in Himachal Pradesh, concentrating mainly between 2000 and 3000 m in January–March, and mostly above 3000 m during September–October.

In Nepal there is an altitudinal movement range of from 3200 to 4350 m (Lelliott and Yonzon 1981), or about 10 000–14 000 ft (Roberts 1981). Compared with the western Himalayas, the snowfall there is not so great toward the east, and so seasonal movements are probably not so great.

#### *Daily activities and sociality*

Beebe (1918–1922) reported that monals choose protected raised ledges on south or south-eastern slopes of steep cliffs or outjutting masses of boulders for their roosting sites. He imagined that this represented a site safe from beech martins, grey foxes, and wild dogs, since the sites were typically 10 or 15 ft above level ground, and furthermore they offered protection from all but the worst storms. He observed three males, including one immature bird, at one such roosting site, as well as feathers of a female or immature bird. In another site he observed the birds arrive at a favourite foraging area one morning. The first male arrived alone, apparently shortly after dawn, and within about the next hour more adult males arrived, singly, in pairs, or in trios, until finally 14 males were present. These seemingly came from different directions, and they fed for about a half-hour, after which they were apparently disturbed and began to leave.

The birds are somewhat gregarious, but the ties between flock members seem to be quite loose, and

probably only during the winter, when the birds are forced into restricted habitats, are real flocks formed. In the autumn females wander down the slopes with their offspring, and during winter rather large flocks of 20–30 birds may gather in chestnut forests (Beebe 1918–1922). During this time an adult male may associate with flocks comprised of females and their young, but typically groups of three or four males associate during the non-breeding season (Baker 1930).

### **Social behaviour**

#### *Mating system and territoriality*

Ridley (1984) judged this species to be polygynous, a condition facilitated by the tendency for females to be gregarious. He judged the pair bond to last from mating to incubation. Baker (1935) also questioned whether the species is monogamous, and certainly the high degree of sexual dimorphism suggests a polygynous mating system.

Locations of individual males are apparently advertised by loud daily calling. Gaston (1981a) reported the calling period in Himachal Pradesh to last from March through June, the same period as he also reported for the western tragopan and kalij. Gaston, Lelliott, and Ridley (1982) suggested that although dispersion of males in spring gives some suggestion of territoriality, 14.5 per cent of the males seen then were in groups of two, and 13 per cent were parts of larger groups of birds (both sexes). Although aggressive behaviour between males was observed in May, these authors believed that strictly observed territorial boundaries did not seem to be present, and that loosely defined home ranges seemed to be a better description of dispersion characteristics. The highest densities occurred in areas close to precipitous crags, which probably provide both safe roosting sites and favourable launching sites for display flights.

#### *Voice and display*

The male's call is a shrill, loud and curlew-like whistle. Beebe (1918–1922) said that the same call is used by the female and her young, although in the case of the young birds it is shriller and higher than in adults. He described the adult call as a high, reverberating whistle, bringing to mind the beat of a dove's wings in flight.

Lelliott (1981b) has distinguished three call types for this species, based on fieldwork with wild birds. The first is a succession of high-pitched piping notes that begin very rapidly, but become more spaced out towards the end of the call, which lasts up to 10 s.



Each note lasts only about 0.14 s, but the intervals between the notes gradually lengthen to about 1 s as the call progresses. This call is uttered by alarmed birds of both sexes, but especially females, as they are flushed. It was also uttered by birds on the ground, in which case it had a seemingly different and unknown function. For example, it might accompany the dawn crescendo call, which consists of a piping whistle of two to five notes, with each set repeated faster, with increasing frequency and amplitude per set, and followed by a slowing and diminuendo of sets. This call was found to be uttered by both sexes at least during spring and autumn, and probably is uttered throughout the year except during the monsoon. The functions of the crescendo call are more uncertain than, for example, the dawn calling of tragopans and the koklass pheasants. Lelliott judged the call to be possibly territorial in function, but inasmuch as it is also uttered outside the breeding season this explanation is not altogether suitable. It may also be simply a concomitant of the nervous excitement of awakening, in the view of Beebe (1918–1922).

The third call observed by Lelliott is the high-pitched whistling note described by various observers as being similar to that of a curlew (*Numenius arquata*). This call was sometimes found as an extension of the piping call, with the ultimate note of that call being extended into a pure tone and repeated at intervals of from 1 to 5 s to form the whistle call. This call might then be uttered for up to 5 min while the bird was perched on the ground or in a tree. It was never heard from a flying bird, and was noted only in females or immatures. Lelliott judged that its function may be that of indicating 'anxiety', and on hearing it other monals would sometimes become alert and utter the same call.

The male's display has been described by a variety of writers (Roden 1899; Wayre 1969; Catlow 1982). Catlow's recent description is most complete, and is based on observation of captive birds. Early stages of display, which occurs between males, have the purpose of establishing dominance. Males stand very tall, with the feathers of the neck, the mantle, and the abdomen strongly fluffed. The beak is held upright and the birds step slowly and elaborately, occasionally lowering the head, causing the crest to vibrate and shimmer. When males are directing the display toward females they may perform the same ceremony, but without feather fluffing, and they also suddenly arch the neck, bringing the crest forward, then call while suddenly raising the head and quickly lowering it again, causing the crest to vibrate violently. Or, the bird may puff out the feathers from the lower mandible around the earcoverts and, finally, the feathers along the top of the

head, making them appear black and increasing the width of the blue skin around the eye. The male then pulls his head in toward the shoulders, with the beak against the upper breast, compresses the neck feathers, and lowers the nearer wing (Fig. 17). Then, with the primaries scraping the ground, he circles the female, leaning toward her and raising the farther wing so that it is visible across his back. He may also tidbit with food items or small stones. The next stage is the direct frontal display, in which the male faces the female and lowers its head while standing erect, half-opening the wings, fluffing the neck feathers, and holding the tail high and fanned. The wings are slowly opened and partially closed, and the tail is slowly flicked up and down. In this posture the white back patch is exposed, and head is oriented so that the crest directly points toward the female (Wayre 1969). The display is normally silent, but the head is sometimes shaken, causing the crest to vibrate and shimmer. This part of the display may last up to 2 min, and is usually the climax. On a few occasions the male may follow the frontal display with other postures, and rarely may call during the climax phase, uttering a very loud, drawn-out churring call of 3–4 s duration, with the head thrown back (Catlow 1982).

Besides these ground displays, a display flight also occurs in wild birds, which consists of an extended gliding, with the tail fanned and the wings held well above the level of the body, and with a repeated piping call that varies from fairly soft to strident (Gaston *et al.* 1982).

## Reproductive biology

### *Breeding season and nesting*

In India these birds begin nesting primarily in May, but egg records extend from 20 April to 27 June (Baker 1935). In north-east Afghanistan and Tibet the season evidently lasts from April to July (Hüe and Etchécopar 1970; Etchécopar and Hüe 1978), although there seem to be no actual nest records for these areas. The altitudinal range during the breeding season is very great, with some breeding in India as low as 8000 ft, and rarely even to 7000 ft, but they also may be seen at 14 000–15 000 ft during the same season.

Nests are invariably placed in wooded habitats, typically in forests having large trees but not very thick undergrowth. The nest is a simple scrape, often under the shelter of a bush, a rock, or in the hole of some large tree. The nest is often unlined, although leaves may collect in the hollow and thus form a lining.



**Fig. 17.** Postures of male Himalayan monal, including normal appearance (A), lateral display to female (B), approaching female (C), and frontal display with tail-fanning (D). After photographs and drawings in various sources, including Schenkel (1956–1958).

#### *Incubation and brooding*

Clutch sizes in the wild are most commonly of four or five eggs, with three-egg clutches also fairly common; sometimes only two eggs are present. The largest reputed clutch of a wild bird was apparently of eight eggs (Baker 1930, 1935; Ali and Ripley 1978) although such clutch sizes are highly suspect (Bates and Lowther 1952). Although there are a few suggestions in the literature that the male helps in caring for the young, this is certainly not the typical situation, and most authorities contend that he takes no part in the rearing phase.

The incubation period lasts some 26–29 days, usually 28 days, and in captivity females will often lay a second replacement clutch if the first is removed or unsuccessful in hatching.

#### *Growth and development of the young*

Not much has been written on this phase, but Wayre (1969) stated that in captivity the chicks are not difficult to rear on starter crumbs, to which has been added live food (maggots and mealworms) for the first few weeks. Sexual maturity is not attained until the second year of life.



### Evolutionary history and relationships

Delacour (1977) suggested that *Lophophorus* is an ancient and long-established genus, with no apparent phyletic links to other genera. I agree with this point, and can suggest no special relationships within the pheasant group. Within the genus *Lophophorus*, the three species form a geographical replacement series that seems to reflect closely their origins and relative phyletic relationships to one another.

### Status and conservation outlook

The status of this beautiful pheasant is still fairly secure in many areas. In some areas of Pakistan it is still fairly common at elevations between 8000 and 12 000 feet, at least in some valleys (Mirza 1981a). In Nepal it is also still locally common, and when afforded protection as in Sagarmatha National Park is quite tame (Roberts 1981). However, where it is hunted it becomes extremely wary and difficult to shoot, although traps and snares take many young birds (Yonzon and Lelliott 1981). In Himachal Pradesh the species has disappeared from some areas, but in others it is still widespread and certainly numerous in a few places (Gaston *et al.* 1981). Thus, in spite of their large size and valuable plumage, the birds seem to be able to cope with humans to a surprising degree.

### SCLATER'S MONAL<sup>1</sup>

*Lophophorus sclateri* Jerdon 1870

Other vernacular names: crestless monal; lophophore de Sclater (French); Weisschwanz Glanzfasan; Stalhuhn (German).

#### *Distribution of species*

Eastern Himalayas and neighbouring southern Tibet, at about the same elevations as *L. impeyanus*, from about long. 93° E east to about long 97° E and probably the Salween River in Tibet, north to at least lat. 30° 20' N in the Po Yigrong Valley and south to northern Burma (Adung Valley and the region of Hpimaw, or about lat. 26° N in the east), east to the mountains of north-west Yunnan on the border of Burma, south to the Shweli–Salween Divide or about lat. 25° 30' N. Sedentary, occurring in ravines and rocky slopes in mountain forest in habitat more or less similar to that of *L. impeyanus* (Vaurie 1965). See map 4.

#### *Distribution of subspecies*

None recognized by Delacour. Davison (1974) has described an eastern race (*orientalis*) in which the tail band is somewhat narrower (10.5–20 mm) than in the nominate western form (20–28 mm wide). Davison considers the range of *orientalis* to extend from the upper Irrawady eastward to north-western Yunnan, and south along the Shweli–Salween watershed.

### Measurements

Ali and Ripley (1978) reported that males have wing lengths of 298–303 mm, and females 285–287 mm. Tails of males range from 194 to 206 mm in length, and a female's was 193 mm (Baker 1930). Cheng *et al.* (1978) noted that three males had wing lengths of 290–310 mm and tail lengths of 195–212 mm, while a female had a wing length of 266 mm and a tail length of 180 mm. Two males weighed 2500 g. Baker (1928, 1930) reported male weights of 5–6½ lb (2267–2948 g) and female weights of 4 lb 11 oz–5 lb (2126–2267 g). The eggs average 63.2 × 45.4 mm, and their estimated fresh weight is 70.5 g.

### Description (after Baker 1928)

#### *Adult male*

A tuft of feathers below the nostril and a narrow line from the upper corner of the nostril to the crown black; crest of short curly metallic feathers blue-green; ear-coverts and narrow line behind the crest black with blue-green reflections; whole mantle deep purple blue-green, more purple on the shoulders; lower back, rump, and upper tail-coverts white with a few black shaft-stripes and, in one specimen, metallic white spots at the tips; tail mottled black, rufous, and white on the basal half, the central portion a rich rufous with a terminal white band; lesser and median wing-coverts bronze-green shot with copper; greater coverts and inner secondaries velvety blue-black; lower plumage velvety black. Iris dark brown; bill dirty white; legs pale greenish; bare orbital skin blue.

#### *Female*

Upper part of head and whole neck vandyke-brown with a buff V-shaped mark on each feather; lores white, mottled with fulvous and brown; sides of head paler than the crown; back, scapulars, adjoining wing-coverts and innermost secondaries rich chocolate-brown with buff central streaks widening into ill-defined rufescent bars; lower back, rump and tail-coverts dull earthy-white, rufescent near the back, more white on the longest tail-coverts, irregu-

<sup>1</sup> Rare species (King 1981).



larly barred with narrow wavy lines of brown, boldest and darkest on the longest tail-coverts; tail black, broadly tipped with white and with six or seven narrow bars of white, the central feathers mottled with rufous on their terminal halves and all with a more or less mottled edge of brown-buff; primaries and secondaries umber-brown, the latter mottled on the margins with buff and brown; remainder of visible wing black with numerous bars of rich chestnut-rufous and very fine buff shaft-streaks; chin and throat white; remainder of lower plumage dull brown, densely covered with tiny wavy bars of dull ochre. Iris brown; bill pale yellow or horny-green; legs dull pale greenish lead colour.

#### *Immature*

Apparently undescribed, but first-year males are probably rather female-like, as in the Himalayan monal.

### Identification

#### *In the field* (21–24 in.)

Found in similar montane habitats as the Himalayan monal (but only locally overlapping with it in range), this species usually occurs above 9000 ft in dense forests having local grassy openings, or above the treeline. Males closely resemble those of the Himalayan monal, but have much more white on the lower back, rump, and upper tail-coverts, and their chestnut tail is also white-tipped. There is only a very short and curly crest, but the rest of the male's plumage is extremely similar to that of the Himalayan species. Females have a paler lower back, rump and upper tail-coverts than do those of the Himalayan species, and additionally they have a distinct buffy tail-band. The calls are evidently very similar to those of the Himalayan monal, and include a shrill, harsh whistle reminiscent of peacocks or guineafowl. The birds are often found in dense fir forests with a rhododendron understorey.

#### *In the hand*

Males can be readily distinguished from the Himalayan monal by their unconstricted and short, curly crest feathers, and the presence of a white tip of at least 10 mm on their tail feathers. Females lack the short crest typical of female Himalayan monals, and are much paler on the lower back and rump. They are also somewhat less coarsely patterned on the underparts than are females of that species.

### Ecology

#### *Habitats and population densities*

Almost nothing is known of this species in its natural environment. Ludlow and Kinnear (1944) des-

cribed the breeding habitat in Tibet as consisting of silver fir (*Abies*) with dense rhododendron undergrowth. It is found at elevations of between 3000 and 4000 m, moving up into the alpine zone during summer. Most probably it also occurs in forest openings and subalpine meadows, and in various seasons its habitats are probably much like those of the Himalayan monal (Ludlow and Kinnear 1944).

There are no estimates of population densities.

#### *Competitors and predators*

Nothing has been written on these. The species is not known to be in contact with the Himalayan monal, although Ludlow and Kinnear (1944) stated that somewhere between the 92nd and 93rd meridian these two species meet.

Predators probably include such large raptors as the golden eagle and various predatory mammals.

### General biology

#### *Food and foraging behaviour*

According to Ludlow and Kinnear (1944), these birds feed during mornings and evenings in small forest openings. Few actual crop or gizzard contents have been analyzed, but among the contents specifically mentioned are *Polygonum* seeds and the heads of thistles or hard-headed flowers (Ali and Ripley 1978).

Foraging behaviour has not yet been specifically described, but the shape of the beak would lead one to believe that it is essentially the same as has been described for the Himalayan monal.

#### *Movements or migrations*

Not specifically described, but no doubt downward movements to snow-free areas occur in winter, while in summer the birds are known to move up to alpine meadow.

#### *Daily activities and sociality*

Limited observations by Ludlow and Kinnear (1944) suggest that even during the breeding season males may remain fairly social, as they flushed three of them from a rhododendron brake in late May. Birds collected at that time had enlarged gonads.

As mentioned above, the birds feed in the morning and evening hours, in the typical fashion of pheasants in this general region. They probably also roost in small groups, like the Himalayan monal.

### Social behaviour

#### *Mating system and territoriality*

Nothing has been written on these, but presumably

they resemble the situation in the Himalayan monal.

#### *Voice and display*

The alarm call has been described as a shrill, hoarse, and rather plaintive, sounding intermediate between that of a peacock and that of a guinea fowl. This call may be uttered repeatedly by a 'sentinel' from an overlooking rock on a steep hillside. The call has also been described as a wild, ringing whistle quite similar to that of the Himalayan monal, but distinct in tone (Ali and Ripley 1978).

#### **Reproductive biology**

##### *Breeding season and nesting*

Birds collected by Ludlow and Kinnear in Tibet during mid-May were all in breeding condition, with one female having an incubation patch and the other having an unlaidd egg in the reproductive tract.

No nests have been described from the wild, and the birds are not known to have bred in captivity. Baker (1935) mentioned a clutch of five eggs that had been brought to him and had been collected between 1 and 3 June at an elevation of about 9000 ft on a peak north of Sadiya.

##### *Incubation and brooding*

The clutch-size, incubation period, and other aspects of breeding are unknown but are probably similar to those of the Himalayan monal.

##### *Growth and development of the young*

There is no information on this subject.

#### **Evolutionary history and relationships**

There can be no doubt that this species is a very close relative of the Himalayan monal, and probably has not been isolated from it for long. Davison (1978*b*) suggested a Pleistocene separation, and commented that the greater width and increased conspicuousness of the white tail band in western populations of the Sclater's monal may be associated with increased possibilities of hybridization with the Himalayan monal in that area, and needs for more effective visual isolation. Western males also tend to have more fulvous rather than blackish underparts and Davison added that this too may be an important species-specific signalling device during frontal display in the two species.

#### **Status and conservation outlook**

This species is currently considered as rare (King 1981). It may already be gone from Nagaland in

India, but until at least 1968 it was still fairly common in some parts of northern Burma, especially at elevations between 2440 and 2745 m (King 1981). Ludlow and Kinnear (1944) observed a considerable number in Pachakshiri, in south-east Tibet, in 1936, but there is no recent information on the status of the species in Tibet.

#### **CHINESE MONAL<sup>1</sup>**

*Lophophorus lhuysii* Geoffrey St Hilaire 1866

Other vernacular names: Chinese impeyan or monal; lophophore de Lhuys (French); Grünschwanz-glanzfasan; Schanzschwänzige Stalhuhn (German).

##### *Distribution of species*

Mountains of north-east Sikang and north-west Szechwan, north to those south-east of the Koko Nor in Tsinghai, and those of southern Kansu; at elevations varying from about 10 000 to 16 000 ft. Sedentary, but no doubt moves altitudinally with the season and has been reported at 9000 ft in the winter. Occurs from the upper limit of the coniferous forest and rhododendrons to the rocky alpine meadows and tundras above the forest and the zone of arborescent scrub (Vaurie 1965). See map 4.

##### *Distribution of subspecies*

None recognized by Delacour. A western race (*chambanus*) was proposed by Meinertzhagen but rejected by Delacour.

#### **Measurements**

Delacour (1977) reported that a single male had a wing length of 345 mm and a tail of 305 mm, while a female had a wing of 320 mm and a tail of 270 mm. Two females measured by me had wing lengths of 285 and 317 mm, and tails of 185 and 228 mm. An adult male weighed 2837 g and a female 3178 g (David Rimlinger, *in litt*). Five eggs (from a captive female) averaged  $71.2 \times 50.4$  mm and had an estimated fresh weight of 99.4 g.

#### **Description (after Delacour 1977)**

##### *Male*

Front featherlets and a patch below the nostrils black; most of face, forehead, and broad superciliary line covered with short black feathers; crown, lower face and ear-coverts iridescent green changing to pink; crest of elongated feathers, slightly constricted

<sup>1</sup> Endangered species (King 1981).



midway to the tips, springing from the hind crown and hanging on the nape changing from purple to bronze; back and side of the neck and mantle rich red copper; scapulars and wing-coverts much as in *impeyanus*; white dorsal patch considerably larger than in *impeyanus*, starting close behind the mantle and extending to the tail-coverts, rarely pure white throughout the greater extent, but white feathers having a small triangular black mark at the tip, which invades most of the tail-coverts; rectrices blue-green, the side feathers spotted with white along the shaft; underparts black, the feathers bordered with metallic blue-green. Iris brown; bill horny brown edged with yellowish; bare skin of face blue; legs horny black, spurs very blunt.

#### *Female*

Face, chin and throat creamy white; upperparts very dark brown, the feathers with a whitish shaft and buff spots along them, becoming mottled on the wings; back white, the upper tail-coverts finely mottled with dark and pale brown; tail barred rufous and dark brown; upper breast and foreneck dark brown spotted with whitish, rest of breast and sides dark brown with large lanceolate white markings; abdomen finely mottled grey and white; under tail-coverts with large buffy white patches. Iris brown; bill horny grey; legs yellowish grey.

#### *Immature*

Apparently undescribed. Probably the adult plumage is attained the second year, as in the Himalayan monal.

### Identification

#### *In the field* (30–32 in.)

This is the only species of monal that is found in China, and thus identification is simplified. Like the other monals, males have velvety black underparts, and also a white rump area. In this species there is no chestnut on the tail, and the birds are appreciably larger than other monals. Females resemble the other monals but besides being larger and generally more contrastingly patterned with dark brown and whitish. The species' calls include a clear and quadrisyllabic vocalization, presumably of the male, that is usually heard in early morning, and sounds something like the native name, *Koa-loong*.

#### *In the hand*

The large size (wing at least 320 mm) and absence of chestnut on the tail of males provide for ready separation from other monal males. Females are larger than in the other two monal species, and have com-

pletely white backs, as well as white to greyish mottling or shaft-streaking elsewhere on the body.

### Ecology

#### *Habitats and population densities*

This species inhabits high montane coniferous forests having a rhododendron undergrowth, which presumably serves as breeding habitat, and also extends during summer into alpine meadows and tundra areas as high as 4880 m. It has also been observed in a rocky scrub margin of alpine larches at 12 000 ft, and probably like the other monals is associated with rocky outcrops that provide hiding places and roosting sites.

No estimates of population densities have been made.

#### *Competitors and predators*

Schäfer (1934) suggested that the golden eagle is this species' only natural enemy. Nothing is known of possible competitors, which are probably few, if any.

### General biology

#### *Food and foraging behaviour*

Practically nothing is known of this. Schäfer (1934) and others have said that the bulbs of an alpine *Fritillaria*, locally called *Pei-mu* or *Be-mu*, is the major food of this species, which digs up the bulbs with its bill. Thus, a local Chinese name for the bird is *Be-mu-chi*, according to Schäfer. In order to get at these bulbs deep holes are dug through the ground cover.

#### *Daily activities and sociality*

Little has been written of this, but probably what has been said of the Himalayan monal applies equally well to this species. Beebe (1918–1922) stated that the birds occur in small parties during the day, sometimes with males and females in separate groups, foraging in open habitats. At night they descend to perch in dense, scrubby and stunted rhododendrons, or in the sheltering branches of pines farther down the mountainsides.

### Social behaviour

#### *Mating system and territoriality*

Schäfer (1934) stated that calling by males occurs regularly during spring and summer mornings, and the few descriptions of the species would suggest that the calls might be louder and carry further than is true of the Himalayan monal. Whether these calls are indications of territorial defence or simply are



used by males to attract females to them is somewhat uncertain even in the Himalayan species.

#### *Voice and display*

Most descriptions of the male's call indicate that it is distinctly multisyllabic, consisting of three or four distinct and separate notes. One Tibetan name *Koa-loong*, is suggestive of the sound that is produced (Beebe, 1918–1922). Schäfer (1934) states that during the call the tail is half-spread in a fan, both wings droop gently, and the upper part of the body, the neck, and head are all strained forward. The bird thus stands with ruffled neck feathers, runs a few steps forward, turns in a circle, stretches its neck, utters the call again, and vaunts its beautiful plumage. The whistled note is uttered every few minutes, starting with a high tone that lasts unchanged for about three minutes, and then gradually shifts to a more mournful tone of deeper range, which eventually fades away. When alarmed, it takes flight with a whirr of wings and utters repeatedly a loud, gabbling whistle.

### **Reproductive biology**

#### *Breeding season and nesting*

Apparently no nests of this species have yet been found in the wild. Some reputed eggs of this species are probably actually those of other species, judging from their relatively small sizes. Cheng *et al.* (1978) describe three eggs as averaging  $73.7 \times 51$  mm, which closely approximates the size of eggs laid by a captive female at the San Diego Zoo (David Rimlinger, *in litt.*). These authors judged the clutch size to be from three to five eggs, laid in April and May (captive birds). Five eggs were also laid by a captive female in San Diego.

#### *Incubation and brooding*

No information is available on this for wild birds.

#### *Growth and development of the young*

Schäfer (1934) stated that in May, when the young have reached the size of a thrush and can fly well, they begin to appear with their mothers. He mentioned seeing a brood of five young out looking for food on a misty morning. When alarmed, the young would hide under their mother's wings, according to him.

### **Evolutionary history and relationships**

This species is geographically separated from the Sclater's monal by the drainages of the YangTze, Mekong, and Salween rivers, but certainly the two populations evolved from a common ancestral type in rather recent times.

### **Status and conservation outlook**

This is classified as an endangered species, and is believed to be rare throughout its Chinese range. It is sought out by hunters and trappers, and it is believed that hunting rather than habitat destruction is mainly responsible for its rarity (King 1981). Very few birds are in captivity, and they are rarely known to have bred under such conditions, making the prospects for saving the species by avicultural methods rather unpromising. However, several nature reserves have been established by the Chinese government within the range of this species, which occurs in much the same area as does the giant panda, and thus the outlook seems more promising than previously (Wang 1980). Among these is the 200 000 ha Wenchuan Wolong Nature Reserve in Szechwan, and a 95 000 ha reserve (Bais-huaijiang) in Kansu, both of which are of subalpine coniferous forest types. Several other similar smaller reserves (to 40 000 ha) in Szechwan are also located within this subalpine ecosystem.

## 6 · Genus *Gallus* Brisson 1760

The junglefowls are small to medium-sized tropical pheasants in which the sexes are highly dimorphic, and males have a unique fleshy comb on the top of the head, one or two lappets below the bill, and an almost entirely naked face and throat. Iridescent plumage occurs in males, and the neck and rump feathers (hackles) are variably lanceolate and ornamental. The wings are rounded, with the tenth primary shorter than the first, and the sixth the longest. The tail is strongly compressed laterally and vaulted, with the central rectrices greatly lengthened and sickle-shaped. The tarsus is longer than the middle toe, and is spurred in males. In females the plumage is duller, the combs and lappets are greatly reduced, and the spurs are lacking. Four species are recognized.

### KEY TO SPECIES (AND SUBSPECIES OF MALES) of *GALLUS* (after Delacour 1977)

- A. Comb, spurs and hackles rudimentary (females).
  - B. Breast almost uniform in colour.
    - C. Breast rufous; upperparts finely vermiculated: red junglefowl.
    - CC. Breast dull pale brown; upperparts strongly marked with black: green junglefowl.
  - BB. Breast strongly patterned.
    - C. Breast mottled with pale buff and dark brown; wings and tail strongly barred: Ceylon (Lafayette's) junglefowl.
    - CC. Breast with brown-edged white spots; wings and tail finely vermiculated: grey (Sonnerat's) junglefowl.
- AA. Comb, spurs and hackles well developed (males).
  - B. Neck feathers short, with broad tips of iridescent green: green junglefowl.
  - BB. Neck feathers dull black or long and narrow.
    - C. Breast striped.
      - D. Breast striped with orange, red and brown: Ceylon (Lafayette's) junglefowl.
      - DD. Breast striped with grey, black and white: grey (Sonnerat's) junglefowl.
    - CC. Breast black: red junglefowl.
      - D. Neck feathers with rather broad, blunt tips; Javan red junglefowl (*bankvia*).
      - DD. Neck feathers with narrow, pointed tips, forming hackles.
        - E. Hackles rather short and dark red, comb small, ear-lobe small and usually red: Tonkinese red junglefowl (*jabouillei*).
        - EE. Hackles long and golden red.
          - F. Hackles yellow at tip, with large and black-

ish central stripe: Indian red junglefowl (*murghi*).

FF. Hackles orange at tip, central stripe brown and narrower.

G. Hackles very long, ear-lobes white and large: Cochinchinese red junglefowl (*gal-lus*).

GG. Hackles moderately long; ear-lobes small and usually red: Burmese red junglefowl (*spadiceus*).

### GREEN JUNGLEFOWL

*Gallus varius* (Shaw and Nodder) 1798

Other vernacular names: Javan junglefowl; coq de Java, Coq à queue fourchue (French); Gabelschwanzhuhn (German).

#### *Distribution of species*

Java and neighbouring islands (Madura, Kangean, Bawean, Bali, Lombok, Sumbawa, Flores, Alor) at low elevations (Delacour 1977). Introduced but probably now extirpated from the Cocos-Keeling Islands. See map 6.

#### *Distribution of subspecies*

None recognized.

### Measurements

Delacour (1977) reported that males have wing lengths of 220–245 mm and tail lengths of 320–330 mm, while a female had a wing length of 195 mm and a tail of 115 mm. Three females measured by me had wing lengths of 180–195 mm and tail lengths of 121–126 mm. No weights are available. The eggs average 44.5 × 34.5 mm, and have an estimated fresh weight of 29.2 g.

### Description (after Delacour 1977)

#### *Male*

Comb, green near the head, passing to mauvish purple and red on the outer edge; one central throat lappet only, red at base with a light yellow patch passing to blue and purple on the outer parts; naked face red; feathers of nape, neck and upper mantle broad and almost square, black with a triple border

of metallic blue, green, and black; lower back and rump with long and narrow hackles, glossy greenish black with narrow light yellow borders; tail of sixteen feathers, glossy blue-green black; hackle-like wing-coverts black with large orange-rusty fringes; rest of wings and underparts dull black. Iris yellow; bill horny yellow, culmen blackish; legs white to pink.

#### *Female*

Crown and cheeks brown; upperparts glossy brownish black, the feathers having pale buff shafts and borders, producing a scaly aspect; tail feathers black with buff and metallic patches on the borders; throat white; breast pale brown with blackish borders to the feathers; abdomen greyish or fulvous with more or less black mottling. Iris yellow; bill horny yellow, culmen brown; legs greyish white to yellowish pink.

#### *Juvenile*

Like the hen; young cocks at the age of two months begin to grow black, green, and yellow margined feathers. Adult plumage is attained by males in their first year, although such birds have slightly shorter feathers, spurs, and combs than older males, and are probably infertile.

### **Identification**

#### *In the field* (16–28 in.)

This species is limited to Java and its immediate vicinity, where it is unlikely to be confused with any species except for the introduced red junglefowl. It is the only junglefowl with a rounded green and purplish comb in males, and has a generally greenish to blackish colouration over most of its body plumage, wings, and tail, except for the yellow-edged rump feathers and the brown-edged wing-coverts. The crowing of the male is a shrill, crisp, and continuous *chaw-aw-awk*, while the female has a slow, repeated cackling *wuk*. Other notes include a repeated *chop*, *chak* or *kowak*. Females are best identified in the field by their very dark tail, and by their spotted or 'scaly' back pattern.

#### *In the hand*

This is the only junglefowl in which the male has broadly rounded and iridescent green neck feathers, and a small, rounded comb that is greenish to purplish. Except for her rounded tail, the female's plumage is reminiscent of *Phasianus*, but the tail feathers are black with an iridescent green sheen, and with buffy edging.

### **Ecology**

#### *Habitats and population densities*

The habitats of this species are reputed to include seashores, coastal valleys, and to some extent inland forests, at least those of low altitude. Dry, rocky scrub around cultivated fields and bamboo or brush thickets are also among their favoured habitats (Delacour 1977).

There are no estimates available for population densities.

#### *Competitors and predators*

Over nearly all of its range this species overlaps with the red junglefowl, and doubtless the two must compete rather strongly. Since the red junglefowl is considerably larger than the Javan species, the latter must be at a considerable competitive disadvantage. However, there is no evidence of interbreeding between the two in the wild, so some kind of ecological isolation perhaps tends to keep them apart.

There is no specific information on possible predators.

### **General biology**

#### *Food and foraging behaviour*

In the wild these birds are believed to forage mainly on noxious insects and weed seeds, and also to regularly visit grainfields. In captivity they consume seeds, greens, berries, and other fruit, and such animal materials as insects and worms. Termites are important foods for young birds (Beebe 1918–1922).

#### *Movements or migrations*

There are probably no movements of significant distance in these birds, for the seasonal temperature changes are limited, and likewise there is no prolonged and severe dry season for the birds to contend with. Indeed, nesting generally corresponds with the dry season, lasting from June to November, when there is an abundance of insect life (Beebe 1918–1922).

#### *Daily activities and sociality*

Observers of the birds in the wild suggest that they are usually to be found singly, in pairs, or at most in family units of no more than about six birds. During the largest part of the day they are said to remain hidden in stunted undergrowth, not venturing out into clearings and fields to forage. At other times they may even go out onto roadways to feed or perhaps obtain grit, and generally remain together in small numbers. At such times the birds can be captured by placing nets at certain openings in the



bushes that lead to rice fields. Then, just before dusk, natives rush through the cover with much beating of sticks. Birds already in the fields rush back to the cover provided by the bushes, and in so doing are captured (Beebe 1918–1922).

## Social behaviour

### *Mating system and territoriality*

In contrast to the other species of junglefowls, it has been suggested that the mating system of this species is probably one of monogamy. Beebe (1918–1922) reported seeing birds only in pairs, and said that observations of semi-captive birds also support the idea of a monogamous pair-bonding, lasting well past the time of hatching. He said that the young may remain with their parents for six or seven months, and that he repeatedly saw both parents leading their broods. However, some other earlier observers had suggested that the birds might be polygynous, with males having harems of as many as four females, which Beebe could not verify.

There does not seem to be any information on territoriality in this species.

### *Voice and display*

The male's challenge call has been described as consisting of three syllables, which are sharp and shrill, sounding like *cha-aw-awk*, and he also utters a slow and cackling repeated *wok* note, as well as a repeated *chop* alarm call. Females utter a fast repeated *kok* call, as well as a loud *kowak*, *kowak* (Delacour 1977). David Rimlinger (personal communication) has observed lateral waltzing and also a frontal display by males, and has further observed that during the last note of the crowing call the male will occasionally clap his wings together overhead, producing a single sharp clapping sound.

## Reproductive biology

### *Breeding season and nesting*

Beebe (1918–1922) indicated that the breeding season is long and rather variable in Java, with as much as several months sometimes intervening between the laying of neighbouring pairs. The season generally occurs between June and November, most often occurring during the first month or two of the east monsoon. According to Beebe this period is one characterized by an abundance of insects and sprouting plant life.

Hoogerwerf (1949) provided nesting records for Java that extended from March to November, with the largest numbers in May and June (eight of a total of 16), and birds from eastern Java seemingly breed-

ing somewhat earlier and over a shorter period than those from western Java (four of seven in April and May).

Relatively few nests have been described in the wild. Beebe (1918–1922) stated that the nest usually consists of a hollow in the ground hidden amongst dense vegetation. Some, however, have been found in ferns growing at some height against a tree trunk, or even in the heart of a tree fern's top. One nest that Beebe found was among some oak-leaf ferns on a ledge that was breast high, in an area of dense cacti and briers. The ledge itself was covered by fire ants, and Beebe believed that such ants provided protection for the sitting bird, which he thought to be immune to their effects.

Beebe judged the average clutch size to be from six to 12 eggs, averaging about eight. However, this is evidently an overestimate, and the average wild clutch is probably only of three or four eggs (Hoogerwerf 1949). However, in captivity the females lay quite freely, sometimes as many as 40 eggs in a season, which is probably related for a high potential for renesting.

### *Incubation and brooding*

The incubation period of this species is 21 days under captive conditions, which is typical of the genus *Gallus*.

### *Growth and development of the young*

Nothing specific has been written on this subject. The young are reportedly quite delicate and susceptible to infections as well as to cold. Two years are required for full attainment of sexual maturity and development of the fully adult male plumage.

## Evolutionary history and relationships

In all respects this species seems to be the most generalized or 'primitive' of all the junglefowls, although its seemingly monogamous mating system has perhaps contributed to its lack of elaborate male displays and plumage specializations. The colours of the females and the shape of the tail show some similarities to those of the genus *Lophura*, but the absence of fertile intergeneric hybrids with any other group of pheasants would argue for a relatively isolated position of the genus *Gallus*. Mainardi (1963) suggested that *Gallus* may be derived from a *Phasianus*-like ancestor, but its immunological distances as well as chromosomal differences indicate differentiation from this group. Relatively close immunological distances were obtained with both *Phasianus colchicus* and *Lophura nycthemera*. Delacour (1977) judged the genus *Gallus* to be isolated and strongly specialized, without a clear appro-

priate location in the sequence of pheasant genera. Within the genus *Gallus* this is apparently the most isolated form (Morejohn 1968a), and although hybridization with *gallus* is possible the F<sub>1</sub> females show reduced fertility, producing young only when backcrossed to *gallus* (Steiner 1945). I have placed *Gallus* earlier in the generic sequence than did Delacour, primarily to emphasize its isolation rather than to suggest specific affinities. However, it may be that such Old World partridge genera as *Galloperdix* are actually more closely related to *Gallus* than are any of the typical pheasant genera. Stock and Bunch (1982) recently compared chromosome morphology and reported that *Gallus* most nearly retains the apparent ancestral phasianid karyotype (as compared with *Crax*, which they considered nearest to the original galliform state), and that it is fairly close to the partridge type found in *Coturnix*, but more distantly removed from *Phasianus*. They also reported that both *Numida* and *Pavo* are relatively primitive in their chromosome structures, support-

ing the general notion that the guineafowl are descendants of an early cracid-like stock from which the partridges and pheasants were both subsequently derived.

#### Status and conservation outlook

Little can be said about the status of this species, but since it thrives in edge and broken environments, and can adapt to the presence of humans, it is likely to be able to survive quite well in spite of its limited geographic range. It is known to occur in high densities in Java's Baluran National Park and also occurs in Ujung Kulon National Park (Sumardja 1981).

#### RED JUNGLEFOWL

*Gallus gallus* (Linné) 1758

Other vernacular names: wild junglefowl; coq baniv (French); Bankivahuhn; Wilduhn (German).



**Map 5.** Distribution of junglefowls, including Burmese (B), Cochin-Chinese (C), Indian (I) and Tonkinese (T) races of red (R) junglefowl, grey (G) or Sonnerat's junglefowl, and the Ceylon or Lafayette's junglefowl (L). See map 6 for remainder of red junglefowl's range. Introduced range of red junglefowl is not indicated.





**Map 6.** Distribution of Burmese (B) and Javan (J) races of red (R) junglefowl, and (stippling) of the green Javan junglefowl (Ja). Both species occur natively on Java, and feral red junglefowl also occur elsewhere in the region.

#### *Distribution of species*

Widespread in south-east Asia, north to the lower ranges of the Himalayas (up to about 6600 ft) from north-east Pakistan eastward to Assam, and southward to at least lat. 17° N on both banks of the Godavari River, encountering *sonnerati* and locally hybridizing with it; also extending east through Burma and across much of Indochina and on the islands of Java, Sumatra, and Bali. Introduced widely, and occurring as domesticated varieties almost worldwide. See maps 5 and 6.

#### *Distribution of subspecies (after Wayre 1969)*

*Gallus gallus gallus* (L): Cochinese red junglefowl. Resident in Cochinese-China, Cambodia and nearby islands, Vietnam (except extreme north) central and lower Laos, eastern Thailand. Intergrades with *jabouillei* in northern Vietnam.

*Gallus gallus spadiceus* (Bonnaterre): Burmese red junglefowl. Resident in south-west Yunnan, Burma, Thailand (except extreme east), northern Laos, Malaya and northern Sumatra. Intergrades with *jabouillei*, *gallus*, *murghi*, and *bankiva* near their respective boundaries.

*Gallus gallus jabouillei* Delacour and Kinnear:

Tonkinese red junglefowl. Resident in Tonkin (northern Vietnam) extreme south-east of Yunnan, Kwangsi and Hainan. Intergrades with *spadiceus* in north-west Tonkin.

*Gallus gallus murghi* Robinson and Kloss: Indian red junglefowl. Resident in northern and north-east India, the lower ranges of the Himalayas from southern Kashmir to Assam, northern and east-central India. From the plains to 7000 ft (rarely), normally not above the foothills; in sal forest and adjacent scrub.<sup>1</sup>

*Gallus gallus bankiva* Temminck: Javan red junglefowl. Resident in the southern half of Sumatra, Java, and Bali.

#### **Measurements**

Delacour (1977) reported that males of *gallus* have wing lengths of 230–250 mm and tail lengths of 260–275 mm, while females have wing lengths of 185–200 mm and tail lengths of 140–155 mm. Ali and Ripley (1978) indicate that males of *murghi* have

<sup>1</sup> Koelz (1954) has described a new race (*gallina*) that Ripley (1961) considers a synonym of *murghi*.



wings of 203–244 mm and tail lengths of 300–380 mm, while females have wing lengths of 177–196 mm and tail lengths of 145–165 mm. Weights of males of *murghi* are from 1 $\frac{3}{4}$  lb to 2 $\frac{1}{4}$  lb (c. 800–1020 g) and of females from 1 lb 2 oz to 1 lb 10 oz (c. 485–740 g). Cheng *et al.* (1978) reported that 10 males of *jabouillei* ranged in weight from 672 to 1020 g, averaging 844 g, and a single female weighed 500 g. They also gave the average male wing length of this race as 216 mm (range 207–223 mm) and the average tail length as 207 mm (range 167–340 mm), for 10 males. The eggs average 45.3 × 34.4 mm, and their estimated fresh weight is 29.6 g.

### Description (after Baker 1928)

#### *Adult male (of murghi)*

Crown of head, nape, upper mantle and sides of neck deep bright orange-red changing to reddish-gold or orange on the longest hackles, which are marked with black down their centres; upper back black glossed with blue or green; lower back deep maroon-red, highly glossed and gradually changing into fiery-orange on the hackles of the rump, the centres of these hackles black but concealed by those overlying them; upper tail-coverts and tail black, brilliantly glossed with green, blue-green or copper-green, the blue generally dominant on the coverts and all gloss absent or obsolete on the outermost tail feathers; least wing-coverts and shoulder of wing black, glossed like the back; median wing-coverts like the lower back; greater coverts black; quills dark brown or blackish, the primaries edged on the outer web with light cinnamon, outer secondaries with much broader edges and the innermost glossy blue-green; underparts blackish brown faintly glossed with green. Iris reddish brown, red or orange-red; comb brick-red to scarlet-crimson; wattles rather more livid red; lappets white, sometimes touched with pink; skin of head bluish or fleshy red; bill dark horny brown, the base and gonys reddish; legs and feet greenish grey to deep slaty brown. Breeding birds have much brighter soft parts than in the non-breeding season. The cock sheds the neck hackles and long tail feathers, the former being replaced with black feathers, which also often appear in patches in the body plumage. This moult occurs in June or July normally and the full plumage is again assumed in October.

#### *Female*

Top of the head blackish-brown, the feathers broadly edged with golden-yellow; in most birds the forehead is more or less metallic crimson, this sheen being produced back as supercilia to behind the ear-

coverts, where they widen and meet on the foreneck as a broad gorget; feathers of nape orange-yellow with broad blackish centres, changing to pale golden-yellow on the longer hackles; upper plumage, wing-coverts and inner secondaries reddish buff or reddish brown with pale shafts and dark brown vermiculations; primaries dark brown edged with rufous; tail dark brown, mottled with dull rufous, absent on the outer pairs; breast dull Indian red with pale shaft-lines shading to dull cinnamon on the abdomen, much vermiculated with brown; under tail-coverts black or blackish-brown. Iris brown; comb and small wattles (sometimes absent), dull crimson; bill horny-brown, base and gape plumbeous-fleshy.

#### *Immature males*

The hackles are less developed and their black centres more conspicuous; their colour is also paler, the cinnamon on the quills is darker and both these and the greater wing-coverts are powdered with blackish. First-year males also have duller spurs than do older males.

#### *Juveniles*

Resembling the adult female, but males soon begin to show red on the black, and start to develop larger and yellower neck feathers (Delacour 1977).

### Identification

#### *In the field (17–30 in.)*

This species, the wild ancestor of the domestic fowl, is familiar to nearly everyone, but its plumages vary considerably according to the degree of domestic or feral influence. However, wild-type males have uniformly golden brown to reddish ornamental neck hackles, a serrated scarlet comb, and a generally blackish-green tail and underpart colouration. The male's crowing call is very much like the familiar call of the domestic form, but the last note is typically more abbreviated. Females are much duller than males, and are generally patterned with dull brown, yellowish, and blackish. Where grey junglefowl also occur the females of the red junglefowl are separable by their paler and more yellowish brown overall colouration, and their rather uniformly rufous-tinted breast, with no indication of the black-and-white spotting that is typical of female grey junglefowl.

#### *In the hand*

Red junglefowl are most likely to be confused with Ceylon junglefowl, and males of the former differ mainly in their unstriped neck hackles, their more

distinctly serrated comb, which also lacks a yellow interior, their brownish rather than purplish black wings, and their blackish rather than brownish underparts. Females are more difficult to separate, but the breast of the red junglefowl is more rufous and less distinctly patterned with black and white, the upper neck is more yellowish, and the wing feathers are not so distinctly barred. Female green junglefowl are also rather similar, but are distinctly more 'scaly' in their dorsal plumage pattern, and show some iridescence on their tail feathers.

### Geographic variation

Geographic variation is marked and clinal in this species, particularly among males. Males of the most northern and westerly form, *murghi*, have unusually long and golden-yellow neck hackles during the breeding season, while those of the most southern and easterly form, *bankiva*, have relatively short and rounded neck feathers. Fairly short and dark reddish neck hackles also occur in the easternmost mainland race *jabouillei*. Males of this race also have small combs and very small ear-lobes, but those of the race *gallus* immediately to the south have large combs and lappets, as well as large white ear-lobes. Females have neck hackles that vary in length and colour in a similar manner to those of males, but these feathers are uniformly shorter (Delacour 1977).

### Ecology

#### *Habitats and population densities*

This species occupies a wide range of habitats throughout its broad range, ranging altitudinally from sea level to at least 6000 ft, and being found in nearly all tropical to subtropical habitats. In general it prefers flat or rolling terrain to steep country, and second-growth or edge habitats to heavily forested habitats. In India the birds occur in forests ranging from fairly mature second-growth and spot-lumbered forests to more open, mixed hardwoods, tropical thorn forests, and the jungles of the alluvial plains. Typically the undergrowth is fairly dense, or if it is open it includes such clumped species as bamboo and lantana. In some areas scrub jungle ravines are used, as are deciduous forest slopes and flats, and in yet other areas sal (*Shorea*) and teak-bamboo forests are also used. In Nepal the birds typically occur in scrub at forest edges, especially among *Zizyphus* bushes and bamboo groves. In Assam, mixed evergreen and deciduous forests are utilized. Pure coniferous forests and wet or boggy habitats are apparently avoided (Bump and Bohl 1961).

In Thailand and Malaya similar habitats are used, including secondary forests associated with abandoned clearings, the edges of bamboo forests (which often sprout after fire and provide an excellent food source for the birds), and similar successional habitats in forested regions. The birds apparently do not occur in primal undisturbed forest, at least in Malaya, and in Thailand apparently do not occur at higher elevations than those supporting bamboo growths (Collias and Saichuae 1967). They have, however, been recorded at elevations as high as 6000 ft in Malaya (Medway and Wells 1976).

In southern China the species reaches about 2000 m elevations, and occurs in a wide variety of tropical to temperate habitats, such as chestnut forests, secondary bamboo growths, mixed broadleaf forests, sparse forests, and shrubby areas (Cheng *et al.*, 1978).

The species is apparently native to Sumatra, but has perhaps been only rather recently introduced into Java; it has become widespread in Indonesia, the Philippines, Micronesia, Melanesia, and Polynesia through introductions (Long 1981).

There are surprisingly few estimates of population densities, but Bump and Bohl (1961) estimated that in the Siwalik foothills area of India a winter density of about a bird per 5–10 acres (25–50 birds per km<sup>2</sup>) might be a conservative judgement. Collias and Collias (1967) estimated on the basis of average flock size and average distances between roosts that a population density of about 2.5 acres per bird (or about 100 birds per km<sup>2</sup>) probably existed there.

#### *Competitors and predators*

Except along the limited area where this species is in contact with the grey junglefowl, it is probably not in serious competition with any other pheasants. Bump and Bohl (1961) judged that the kalij pheasant is probably not a serious competitor with the red junglefowl, although the males sometimes fight to the death during the breeding season.

These same authors mentioned several potential predators of the red junglefowl in India, including the mongoose, jungle cats, various hawks, and great horned owls, but found no evidence that any of these posed serious problems to the birds. Collias and Collias (1967) listed a considerable number of potential predators in India, but found no direct evidence for any of these being important. Collias and Saichuae (1967) also mentioned that various hawks, eagles and a variety of small cats reportedly prey on red junglefowl in Thailand and Malaya, but had little direct evidence of this. Additionally, a fishing cat (*Prionailurus viverrinus*) and a palm civet (*Paradoxurus hermaphroditus*) were reported as predators by a native guide, and there is a report of a yellow-



throated marten (*Martes charronia*) trailing a flock of these birds. Goshawks (*Accipiter badius*) and serpent eagles (*Spilornis cheela*) have also been seen near flocks of junglefowl in Thailand. Various snakes and lizards may be important egg predators in the area.

In China, reported predators include jungle cats (*Felis chaus*), yellow martens (*Mustela sibirica*), sparrow hawks (*Accipiter nisus*), various falcons, owls, etc. Other predators such as snakes, lizards, rodents, and small carnivores probably consume eggs and chicks (Cheng *et al.* 1978).

## General biology

### *Food and foraging behaviour*

Most evidence indicates that these birds are highly opportunistic and omnivorous. In India, a sample of 37 crops revealed no less than 30 kinds of seed and many types of insect present. Some of the plant genera represented in the crops of two or more birds were *Trichosanthes*, *Rubus*, *Carissa*, *Zizyphus*, *Shorea*, *Digitaria*, *Stellaria*, and *Oryza*, of which only the last-named (rice) was a cultivated grain. The insects included representatives of ants, beetles, termites, true bugs, and flies, and there were other invertebrates such as snails, spiders, and millipedes represented as well.

Collias and Saichuae (1967) reported on the food contents of 23 adult junglefowl collected in Thailand, and these also consisted of a large mixture of plant and animal materials. Important plant contents included the fruits of various Euphorbiaceae, seeds of bamboo, fruits of *Zizyphus* and Acanthaceae, and materials from such crops as maize, rice, beans, and tapioca. Animal foods found were primarily insects, especially termites and ants, with as many as almost 1000 termites counted in the crop of a single male.

In China, the foods are similarly diverse, and include nuts, seeds, bamboo shoots, leaves, petals, cultivated grains, drupes, berries, and the like. Termites, their eggs, and other insects are also eaten in quantity (Cheng *et al.* 1978).

Collias and Collias (1967) stated that junglefowl seem to eat a wide variety of foods as they become seasonally available, and typically scratch about in the leaf litter individually, with an apparent peck-order relationship determining access to favourable foraging locations.

### *Movements or migrations*

There is little evidence of seasonal migrations in this species, although Bump and Bohl (1961) suggest that in the winter birds from the higher areas are

forced into lowlands. There are also some unsubstantiated reports of seasonal migrations to rainforests in Thailand during the rainy season (Johnson 1963).

Most observers have found these birds to be relatively sedentary, with limited home ranges (Collias and Collias 1967; Collias *et al.* 1966).

### *Daily activities and sociality*

The daily activities of these birds centre around their roosts, which tend to remain constant unless they are disturbed. The birds roost socially in trees, and forage from dawn to about 9 a.m., and again from about 3 or 4 p.m. until dusk. During the dry season the birds also regularly visit water holes, typically drinking early in the morning, and again in the evening. The birds move about as they forage, but at least some have rather restricted daily movements of sometimes as little as about 150 yd in diameter. During the hottest part of the day the birds rest in or near the roosting trees (Collias and Collias 1967).

Although Collias and Collias found the average number of birds using a single roost to be only about five, there is an early account of as many as 30 birds seated side by side on a single bamboo (Beebe 1918–1922).

## Social behaviour

### *Mating system and territoriality*

Although a few earlier writers believed this species might be monogamous, most recent studies have supported the idea that it is regularly polygynous (Bump and Bohl 1961; Collias and Collias 1967). Collias and Collias found single males to be in association with from as few as no females to as many as four, but early in the breeding season there were fewer polygynous pairings, while later on there were cases of males in company with single females, after some of the females had gone off to incubate their eggs. Several single unmated males or groups of males were also observed, presumably reflecting first-year birds or other older males unsuccessful in obtaining mates.

Territories are presumably established and proclaimed by crowing; Collias and Collias (1967) believed that crowing helps to reinforce the territorial relationships, facilitates spacing, and reinforces dominance relationships within a flock. Crowing by one male tends to stimulate it in others, and sometimes also attracts others. Much of the crowing is apparently associated with territorial patrolling; subordinate males apparently crow much less than do dominant birds.



### Voice and display

The crowing call of the male is the familiar four-noted 'cock-a-doodle-doo' of the domestic fowl, but the individual notes tend to be run together. The third note is the most sustained and has the highest amplitude (Collias and Collias 1967). Individual differences in crowing characteristics occur, and may allow for individual acoustic recognition (Miller 1978).

Crowing is most intense during early morning hours, being slightly earlier each morning as the breeding season progresses. Typically a sharp peak in crowing occurs shortly after dawn, and there is often a secondary peak before sunrise, probably coinciding with the birds' initial movement away from the roost to foraging and drinking areas. There is usually little crowing during the day, but a minor peak occurs before sunset as the birds go to roost (Collias and Collias 1967).

The social displays of the red junglefowl have been discussed in an earlier chapter, and need not be repeated here. In the wild there seem to be relatively few actual fights among males, although subordinate males may persistently follow a male and his harem. Males attract their harem to them by uttering their distinctive food-call associated with tidbitting behaviour, and this behaviour (Fig. 10) as well as copulatory behaviour is apparently the same in wild junglefowl as in domesticated forms (Collias and Collias 1967).

## Reproductive biology

### Breeding season and nesting

In India, the breeding season of this species corresponds with the dry season in spring, and is centred on the period March to May. This also corresponds to the cycle of crowing, which in northern India peaks in early May, and declines by early June (Collias and Collias 1967). However, for the country as a whole, eggs have been found from January to October (Bump and Bohl 1961).

On the Malay Peninsula the nesting season is apparently quite seasonal, with nests having been found from December to May (Medway and Wells 1976). The peak of the nesting season there seems to be in January and February (Glenister 1951).

In China, breeding begins as early as February in southern Yunnan, and reaches a peak between March and May. Apparently some nests have been reported as late as October (Cheng *et al.*, 1978).

Nests are found in a wide variety of locations, but the birds prefer dense secondary growth, bamboo forests, and other dense growths. Often the nests are placed under a bush or in a bamboo clump; when

placed in the middle of a bamboo clump they may be elevated a few feet above the ground.

Clutch-sizes are apparently normally of five or six eggs, with four also frequently found, and rarely as many as nine present. Estimates of clutches larger than nine are probably in error (Baker 1930).

### Incubation and brooding

Incubation is by the female alone, and under natural tropical conditions takes about 20 days (Baker 1930). Cheng *et al.* (1978) report the period as between 18 and 20 days. Although only one brood is produced per year, renesting is typical when the eggs have been destroyed before hatching. Renesting efforts typically have only three or four eggs (Bump and Bohl 1961).

### Growth and development of young

The mother and the chicks leave the nest site as soon as the last young is dried, and thereafter the female leads them about. The chicks are able to fly at a surprisingly early age, and when they are no more than a quarter grown. It is uncertain as to how long the chicks remain with their mother in nature, but in captivity the period of association lasts for at least three months (Collias and Collias 1967). There have been some observations of males attending females with broods, although it has been asserted that the male does not roost with them while they are growing (Cheng *et al.* 1978). Broods often stay together well into the autumn (Bump and Bohl 1961). Sexual maturity is attained by the end of the first year, but the males are at that age not in full plumage and probably remain sexually subordinate to older and more experienced males for some time.

## Evolutionary history and relationships

Comments have been made in the section on the green junglefowl as to the evolutionary affinities of the genus *Gallus*. The red junglefowl seems to have a somewhat central position in the genus, with plumage similarities to several species. Thus, Beebe (1918–1922) mentions that it resembles *varius* in the ventral plumage of males, and *lafayetti* in male dorsal plumage. However, females show a similarity to *sonnerati* in female dorsal plumage. The relationship with *sonnerati* is apparently close, since there seems to be complete hybrid fertility between these two species (Danforth 1958), and there is natural hybridization known in the limited zone of sympatry between the two species.

## Status and conservation outlook

This species is not a problem for conservationists, since it breeds more commonly in disturbed second-

growth habitats than in undisturbed forests. In its domesticated form it is probably the most abundant bird in the world, with populations numbering in the several billions.

## GREY (SONNERAT'S) JUNGLEFOWL

*Gallus sonnerati* Temminck 1813

Other vernacular names: coq de Sonnerat (French); Sonnerathuhn (German).

*Distribution of species* (after Ripley 1961)

Peninsular India north to southern Rajasthan (Mt. Abu), Gujarat, Madhya Pradesh, and Andhra Pradesh to Polavaram, occurring from plains level to 5000 ft; in evergreen as well as scrub, bamboo, teak, and mixed deciduous forest. See map 5.

*Distribution of subspecies*

None recognized by Delacour (1977). Koelz (1955) has described a race (*wangyeli*) that was not accepted by Ripley (1961).

## Measurements

Delacour (1977) reported that males have wing lengths of 220–255 mm and tail lengths of 330–390 mm, while females having wing lengths of 200–215 mm and tail lengths of 130–170 mm. Ali and Ripley (1978) reported male wing lengths of 220–255 mm and tail lengths of 314–390 mm, and females having wing lengths of 190–215 mm and tail lengths of 100–170 mm. Adult males weigh from 1 $\frac{3}{4}$  to 2 $\frac{1}{2}$  lb, (c. 790–1136 g), and females from 1 lb 9 oz to 1 $\frac{3}{4}$  lb (c. 705–790 g). Eggs average 46.3 × 36.5 mm, and their estimated fresh weight is 33.4 g.

## Description (after Baker 1928)

### Adult male

Feathers at the side of the forehead dull rufous; head, neck, and hackles of the extreme upper back black, with grey fringes to the bases and with numerous bars of golden-yellow on the nape, neck, and shoulders changing to pure white on the back; on the longer feathers the black bars are glossed with purple-blue; back, rump and wing-coverts black fringed with grey, with broad white shaft-streaks and the majority of the feathers with concealed longitudinal grey streaks; longest and lateral rump feathers fringed chestnut, glossed with purple and spotted with pale yellow or white; upper tail-coverts black, glossed with violet, purple and blue and edged with buff and chestnut; median wing-coverts and scapulars black, barred on the basal half with grey

and with white shafts expanding at their tips into flat spatulate plates of orange-yellow about 25 mm long by 5 mm wide, the majority of which have deep red fringes on the outer side; greater coverts and quills blackish brown; the innermost secondaries and coverts with white shafts and sometimes freckled with whitish near the tips; lower parts from the hackles to the vent dark brown or blackish with white shaft-streaks and grey or grey-white edges to the feathers; feathers of the posterior flanks and a few on the abdomen with orange-rufous edges; feathers of vent and centre of abdomen dull rufous-brown; under tail-coverts black with white edges. Iris yellow to bright red; culmen black, the upper mandible at the base and most of the lower mandible yellowish horny; legs and feet yellow or reddish yellow; claws black. The eclipse (post-nuptial) plumage has no long tail feathers and the neck hackles are replaced by short dull brownish black feathers.

### Female

Upper part of the head dull pale brown, rufescent on the forehead and with faint white streaks; neck golden-brown, feathers white-shafted and with brown bands on each web, increasing in size on the mantle; whole upper plumage and wings finely vermiculated pale sandy-brown and dull black; tail dull rufous-black mottled with rufous on the edges of the central tail feathers; below white, each feather edged with dark brown and slightly speckled with the same; flanks mottled sandy brown and brown with broad white central streaks. Rudimentary comb and bare skin of face brick-red to dull crimson; otherwise as in the male but the legs more yellow.

### Immature male

Similar to the female, but with a black tail and scattered grey and rusty feathers. First-year males acquire a plumage much like adults, but have shorter and duller feathers, short combs, lappets and spurs, and mottled brown and black wing feathers. They are usually infertile.

## Identification

### In the field (15–30 in.)

Although limited to southern India, in some areas this species may be found where the red junglefowl exists in wild or feral form, and might be mistaken for it. The grey junglefowl is usually found only in pairs or small family groups, and its usual call is quite different, sounding like *kuck-kaya-kaya-kuck*, ending with a low *kyukun*, *kyukun*, which is repeated slowly. The male's crow has also been described as *kuk-ka-kurra-kuk*, and as unmusical and



curiously grating and halting in quality. A clicking sound also is uttered. Males are almost uniformly greyish in appearance, lacking the red junglefowl's yellow to brownish neck, rump and wing colouration, while females are generally darker brown and less yellowish in the neck region than those of the red junglefowl. Their underparts are also more distinctly spotted and mottled with black and white, rather than tending to uniform reddish brown to buffy.

#### *In the hand*

Male grey junglefowl are the only species having greyish neck hackles ornamented with golden yellow spotting; such spotting also occurs on the rump and the wing-coverts. Females are best identified by their vermiculated dark brownish and blackish tail, and their mottled black and brown wing feathers, rather than the distinctly barred condition of green and Ceylon junglefowls or the brown and mottled rufous wing and tail colouration of the red junglefowl. Males in breeding plumage are unique in having the tips of the neck hackles, median wing-coverts, and scapulars specialized in that the shafts are expanded terminally into flat plates of orange-yellow, most of which are fringed outwardly with deep yellow. These tips are lacking in the 'eclipse' plumage, but young males show them to a limited extent.

### Ecology

#### *Habitats and population densities*

This species inhabits a wide variety of habitats, from secondary dry-deciduous forest to moist evergreen forests, but is especially common in mixed bamboo jungle, the edges of forest villages, around cultivated fields, and in abandoned clearings or neglected plantations. It is primarily associated with broken foothill country, but also occurs up to the highest peaks of about 2400 m in the Nilgiris and Kerala ranges (Ali and Ripley 1978). In the south it extends to the coastline, but in the north it encounters the red junglefowl in the vicinity of the Godavari River. The grey junglefowl only locally occurs north of this river, its tributary the Indravati, or the Nerbudda to the west, where the species' northern limits are attained in the vicinity of the Avaralli Hills (Beebe 1918–1922).

Collias and Collias (1967) reported that the habitat of this species is very similar to that of the red junglefowl, although it is typically more open and rocky, and the more greyish colour of the males seems to match closely the rocky background colour. When in vegetation these birds seem to prefer

areas covered with shrubs, small trees and euphorbias over grassy clearings.

There are no available estimates of population densities in this species, but Baker (1930) reported that along quiet jungle roads as many as 15 birds have been seen within the space of a few miles.

#### *Competitors and predators*

Certainly at the northern edge of its range the red junglefowl must be a significant competitor. Beebe (1918–1922) suggests that the birds also feed in the same areas as spurfowl, bustard-quail, and other small granivorous birds, which probably are not significant competitors. However, they often associate with various species of babblers (Timaliidae) and the two groups apparently mutually benefit, with the babblers catching insects that are flushed by the junglefowl, and the junglefowl using the babblers as effective look-outs for possible danger.

Beebe believed that several raptors, such as the Bonelli eagle (*Hieraeetus fasciatus*) and the crested hawk-eagle (*Spizaetus nipalensis*), are significant predators, particularly the latter, and that such mammalian predators as leopards, various other cats, and especially mongooses are also no doubt important enemies. He also mentioned pythons as a possible source of danger.

### General biology

#### *Food and foraging behaviour*

Foods of this species are very diverse, and include grain, shoots of grass and crops, tubers, berries of *Zizyphus*, *Lantana*, *Streblus*, etc., windfallen figs (*Ficus* spp.), and the seeds of bamboo and *Strobilanthes*, the latter of which are especially favoured by the birds. Animal materials include insects, especially grasshoppers and termites, and even small reptiles (Ali and Ripley 1978). After fields have been burned over the birds seem to enjoy the tender, juicy sprouts of freshly growing grasses, and a young chick was found to have filled its crop with soft vegetable matter, some tiny beetles, and a small moth (Beebe 1918–1922).

When foraging, the birds do not wander far from cover, and at the first indication of danger quickly dart back into heavy brush. However, when surprised in the open they typically fly rather than flee on foot, and head for the nearest cover. They typically forage day after day in the very same area, and at about the same time each day (Baker 1930).

#### *Movements or migrations*

According to Beebe (1918–1922) there are no seasonal migrations in this species, although there may



be a considerable amount of wandering for food during different seasons, as particular food sources become locally available. When the seeds of *Strobilanthès* become locally available hundreds of individuals may gather for a few weeks until the food supply has disappeared.

Baker (1930) mentioned an individually recognizable male that regularly foraged each morning and evening in two localities nearly a quarter of a mile apart for an extended period.

#### *Daily activities and sociality*

Like other tropical pheasants, these birds forage only in the mornings and evenings, retiring to heavy cover during the middle of the day, except on cloudy days when they may remain out for most or all of the day (Baker 1930).

They are not highly social, with the birds usually occurring singly or in pairs, or at most in family units of up to about five birds. Even roosting is apparently done non-socially, even though several birds may be found in the same tree or in neighbouring ones (Beebe, 1918–1922).

### **Social behaviour**

#### *Mating system and territoriality*

Ali and Ripley (1978) contend that the mating system of this species is one of serial polygyny, with males pairing with individual hens as they become physiologically mature. Beebe (1918–1922) believed, however, that pairs are associated throughout the year. Although under certain circumstances a male may mate with two or three hens, he considered that monogamy is the normal condition. Certainly in captivity the birds are facultatively polygynous, with three or four hens apparently the ideal number to mate with a male (Johnson 1964).

Like the other junglefowl, males of this species seem to be seasonally territorial, and the crowing season seems to last longer than the actual breeding season, or from about October or November until May. The calls are typically uttered from trees in very early morning, but sometimes also at night, especially when there is moonlight. Territorial or home range sizes have not been estimated for this species.

#### *Voice and display*

A good deal has been written on the male calls of this species, which are rather distinct from those of the red junglefowl. A loud wing-flapping, producing a clapping sound, typically precedes the crowing call. A single crow consists of four component notes, as in the red junglefowl, and the duration of the call

is about the same. However, the individual notes are more discrete, and each of the notes is more varied in pitch. The second note appears to the human ear to be the most strongly emphasized note, although all four are actually of about the same amplitude (Collias and Collias 1967).

Display in this species is not well described, but it has sometimes been mentioned as similar to that of the red junglefowl. Morejohn (1968*b*) stated that males of both species perform tidbitting behaviour, but that the associated call is markedly different in the two, with that of the grey junglefowl sounding similar to the nasal mewling of a cat. Morejohn did not describe waltzing behaviour in this species, but found that after four or five months of contact with a male grey junglefowl, a female red junglefowl would respond to his tidbitting call and presumably to his other courtship displays as well. Fertility and hatchability of these matings were even higher than those of intraspecific matings of either species, and the resulting hybrid males courted all three types of female (grey, red and F<sub>1</sub> hybrids), with backcross young being produced in both directions. However, no F<sub>2</sub> young were successfully raised, suggesting some genetic isolation between the species that apparently supplements geographic isolation and behavioural isolating mechanisms.

### **Reproductive biology**

#### *Breeding season and nesting*

The breeding season is quite prolonged, and probably conforms to the period of male nuptial plumage. Most breeding records are for the period February to May, beginning somewhat earlier in the south, but locally extending more or less throughout the year (Ali and Ripley 1978). In the western Nilgiris the main breeding months may be from October to December, while in Travancore breeding occurs from March to July, and sometimes until August (Baker 1930).

The nests are located in small hollows, often in the shade of a bush, a bamboo clump, or rarely elevated on a dead tree or stump. Most records of wild clutches are of no more than four or five eggs, and sometimes only three, but occasionally clutches of six or seven have been recorded, perhaps as a result of the efforts of two females (Ali and Ripley, 1978; Baker 1930). Beebe (1918–1922) has suggested that clutch sizes are larger at the southern end of the range than they are in more northern areas.

#### *Incubation and brooding*

Incubation is performed by the female alone, and lasts some 20–21 days. However, when the young

are hatched the male apparently returns to the brood and is often seen with them, taking his part in finding food for them (Beebe 1918–1922). This behaviour, if general, would certainly argue for a normally monogamous mating system.

#### *Growth and development of the young*

The young are quite precocial, and are able to fly a few days after hatching. Even before that stage is reached the chicks will clamber up into shrubs and bushes, then leap off and flutter a short distance before falling to the ground. The notes of both the female and the chicks are very much like those of the domestic fowl. The chicks remain with their parents at least until they have attained their 'adult' (presumably first-year) plumages, and perhaps for longer than that (Beebe 1918–1922). First-year males are usually infertile, and the full adult male plumage is not attained until the second year.

#### **Evolutionary history and relationships**

Morejohn (1968*a*) has compared the plumages of the four species of *Gallus*, and has concluded that *gallus* and *sonnerati* may have differentiated into separate forms north-east and south-west of the Godavari River respectively, with the grey junglefowl becoming adapted to a generally more xeric, scrub-jungle environment, and the red adapting to an area of mixed jungle and grasslands in a more mesic climatic region. Wild hybridization does not occur in the area of contact, but hybridization between the grey junglefowl and domestic fowl in the vicinity of native villages has been reported. The two forms have certainly attained the level of full species, and have supplemented their geographic isolation with differences in plumage, behaviour, and intrinsic genic differences that result in reduced hybrid fertility and viability (Morejohn 1968*b*).

#### **Status and conservation outlook**

There is no apparent reason for concern about the status of this species, which thrives near humans and in second-growth habitats.

### CEYLON JUNGLEFOWL

*Gallus lafayettei* Lesson 1831

Other vernacular names: Lafayette's junglefowl; Cingalese junglefowl; coq de Lafayette (French); Lafayette-Huhn (German); wali-kukula (Native Ceylonese).

#### *Distribution of species*

Limited to Ceylon (Sri Lanka), occurring between sea level and 6000 ft, from damp mountain forests to coastal scrub. See map 5.

#### *Distribution of subspecies*

None recognized by Delacour (1977). Deraniyagala (1957) has described a race (*xanthimaculatus*) that was not accepted by Ripley (1961).

#### **Measurements**

Delacour (1977) reported that males have wing lengths of 216–240 mm and tail lengths of 230–400 mm, while females have wing lengths of 170–180 mm and a tail length of 110 mm. Ali and Ripley (1978) reported that eight males had wing lengths of 228–239 mm and tail lengths of 290–338 mm, while three females had wing lengths of 187–195 mm and tail lengths of 108–118 mm. Males weigh from 1¼ lb to 2½ lb (c. 790–1140 g), while females weigh from 1 lb 2 oz to 1 lb 6 oz (c. 510–625 g). The eggs average 46.3 mm × 34.5 mm, and their estimated fresh weight is 30.4 g.

#### **Description (after Baker 1928)**

##### *Adult male*

Crown dull orange-rufous; feathers at base of naked throat rich violet purple; hackles on neck and upper back orange-yellow, shading into this from the rufous head and again into fiery orange-red on the back, the yellow feathers with black central streaks and the red with rich maroon; lower back and rump darker, almost copper-red, the centres to the feathers deep violet-blue; the central and least lanceolate feathers have a broad terminal patch of violet-blue; a few of the longest tail-coverts black, narrowly edged fiery-red; tail black, glossed with deep blue or blue-green; lesser wing-coverts like the neck, grading into the median, which are like the back; greater coverts black, mottled rufous and black on the concealed portions; breast and flanks like the back, the short feathers near the abdomen rufous-chestnut with broad black terminal bands; vent and centre of abdomen dull brown-black with paler tips; thighs black, the feathers fringed chestnut; under tail-coverts glossy blue-black. Iris light golden yellow; face, throat and wattles livid or purplish red, comb bright red with a large interior yellow patch; bill brownish red, the tip and lower mandible paler; legs and feet wax-yellow to pale yellowish-brown.



*Female*

Forehead dull rufous-red; crown dull brown with fine black specks; nape, sides of neck and sparse feathers of throat dull rufous; mantle blackish brown with pale shaft-streaks and golden-buff edgings; remainder of upper plumage pale buff, rufous-buff or rufous-brown vermiculated all over with black, the tail more boldly barred with black and pale buff; primaries and outer secondaries pale brown mottled on the outer webs with black and buff; inner secondaries vermiculated brown and buff in the centre, boldly barred with black and buff on both webs and showing chestnut marks here and there; a black patch below the throat; upper breast and flanks vermiculated black and rufous-brown; remainder of abdomen, breast and thigh-coverts white, each feather edged with black and with black bars near the base. Iris olive-yellow; bill dark brown above, yellowish below; legs and feet brownish-yellow.

*First-year male*

Similar to adult, but with crest and lappets slightly developed, neck feathers short and broad, purplish black with yellowish brown fringes, the throat feathered and dull buffy brown, the long curved central tail feathers lacking, spurs shorter, and plumage generally duller (Delacour 1977).

*Juvenile*

Male like the female but more rufous below.

**Identification***In the field* (14–28 in.)

The limited Ceylonese range of this species eases identification, although feral red junglefowl might make the problem greater. Males differ from those of red junglefowl in having reddish brown underparts, brown streaking through the yellow neck hackles, and the interior portion of the comb tending toward yellow. Further, the wings are dark, iridescent bluish black, rather than reddish brown. The male's crow is a distinctive three-syllable, musical and ringing *chick, chaw-choyik* (or 'tsek . . . George Joyce'), with the beak jerked sharply upward with each syllable. Crowing is often preceded by a vigorous wing-clapping of three or four beats. Females have a more strongly barred wing and tail patterning than do female red junglefowl, and lack the yellow neck tones of that species.

*In the hand*

The male's brown-streaked neck hackles and brownish underpart colouration allow for easy identification

from all other junglefowls, while the female is best identified by the heavy brown, blackish, and buffy barring on the wings and the brown and black markings on the tail. The comb of the male is less fully serrated than that of the male red junglefowl, the iris is yellow rather than red, as is the interior of the comb, and there are no distinct ear-lobes. The legs are reddish, with sharp brownish to blackish spurs, rather than having greyish to brownish spurs and legs. Hybrids with domestic fowl sometimes occur in the vicinity of native villages, and might pose identification problems.

**Ecology***Habitats and population densities*

This junglefowl is ecologically quite widespread, occurring from tall forests that originally covered the sides of hills and mountains to low *Euphorbia* and other types of scrub jungle typical of the coastline and elsewhere. It also commonly occurs in bamboo thickets, brush, semi-cultivated areas, and in secondary growth following old cultivation or other disturbance (Baker 1930). Its vertical distribution ranges from the seacoast up at least to about 6000 ft, and is commoner in the eastern and drier areas of Sri Lanka than in the damper areas to the west and south-west (Beebe, 1918–1922).

There are no estimates of population density, but pairs have been known to breed as close as 200 yd apart (Beebe 1918–1922), suggesting a relatively high density in favoured habitats. Collias and Collias (1967) counted 24 males crowing within earshot along a one-mile (1.6 km) stretch of road in Wilpatus National Park, in an area known to have one of the densest populations of junglefowl in the Park. This area was dense enough to provide good cover, but not too dense to walk through easily. Further, there were many termite nests, as well as an abundance of fruiting trees and shrubs, which seem to be important food sources for young and adults respectively.

*Competitors and predators*

This is the only species of junglefowl native to Sri Lanka, although the red junglefowl is common as a domestic bird, and perhaps feral flocks might locally exist in competition with the native species.

Perhaps the most serious native predator is the mongoose (*Herpestes* sp.) according to Beebe (1918–1922), who on several occasions observed these animals stalking junglefowl. He also mentioned the jungle cat (*Felis chaus*) as a potential predator, and commented that ticks may be the cause of a greater number of deaths than might be appreciated.



## General biology

### *Food and foraging behaviour*

Beebe (1918–1922) reported on the crop contents of eight birds shot in March, which included a wide variety of plant and animal materials. Among the plant contents were grass seeds, seed-pods, berries, and flower petals, while the animal materials included scarab beetles, termites, molluscs, wood lice, ticks, centipedes, hemipterids, ants, a wood roach, and a grasshopper. Termites were found in four of the eight birds, and one of the crops had several hundred termite workers present. Four of the crops contained grass seeds, and green seedpods were present in three of them. Beebe believed that termites are the most important part of the animal diet of junglefowl. He confirmed that one of their favourite plant foods is the berries and seeds of the *nilloo* or cone-head plant (a variety or species of *Strobilanthes* and *Stenosiphonium* that occur from about 5000 ft upwards and flower only infrequently). The seeds of these plants are reputed to cause the birds to become temporarily intoxicated and relatively helpless, although Baker (1930) questioned this belief.

Males and females forage in grassy strips along jungle roads in the mornings and evenings, especially after rains. They do not remain out very long, however, except that when the weather is wet and cool they may remain out foraging all day long (Baker 1930).

### *Movements or migrations*

There are apparently few movements of any great length in this species. Beebe (1918–1922) considered the birds to be highly sedentary, with little seasonal shifting. He judged that two pairs inhabited a very small area of semi-desert scrub for a year and a half, without ever leaving this location. However, when the *Strobilanthes* is in fruit the birds are attracted from lower areas 'far and near', according to Beebe.

### *Daily activities and sociality*

There are apparently well-marked daily patterns of foraging, as mentioned above, with morning and evening periods of activity. During the middle of the day the birds seek out shady areas in which to roost, and also roost at night. Beebe (1918–1922) stated that he never saw more than five birds together at one time, and judged that group to represent a family unit. He believed that the species is relatively unsocial except that at times when several females and their broods may be found flocking, such as during the early life of the chicks.

## Social behaviour

### *Mating system and territoriality*

Beebe (1918–1922) judged this to be facultatively monogamous or polygamous, with no special predominance of one over the other. He knew of several pairs of monogamously mated birds, as well as of other cases where two hens were undoubtedly mated to the same male. Three females were the largest number of females that he heard of as being mated to a single male. Baker (1930) considered the species to be 'apparently polygamous', with no indication of the male taking any interest in caring for his chicks.

Territorial proclamation, or at least male sexual advertisement, occurs in the usual junglefowl manner, with calling occurring through most or all of the year. Beebe (1918–1922) stated that males have definite territories that they announce daily by crowing. Calling begins on the roost itself, and the bird then moves lower in the roosting tree and continues crowing for a variable period. Calling begins at the first hint of dawn, at about 5:15 a.m. and is at its peak just before sunrise, about 5:30 a.m. It begins to diminish about a half-hour later, and is usually over by 9:00 a.m. In the evening there is a second period of calling, but it is not so enthusiastic as the morning calling, and on cloudy days calling may occur periodically throughout the day.

### *Voice and display*

The crow of the Ceylon junglefowl is of three discrete and well-separated notes, but its total duration is slightly shorter than that of the red or grey species, in spite of a marked interval between the first and second notes. There is little difference in the amplitude of the three components, but there is a marked variation of the frequency of the individual notes (Collias and Collias 1967).

During calling the male stands on its toes, and it often flaps its wings. Wing-clapping is apparently an important aspect of the display, since males can be readily 'called up' by imitating the clapping, whilst imitation of the crowing call is less effective in this (Beebe, 1918–1922).

Detailed descriptions of male posturing are not available, but it evidently differs but little from that of the red junglefowl.

## Reproductive biology

### *Breeding season and nesting*

According to Beebe (1918–1922), eggs are laid during almost every month of the year, with February to May being the most usual period for the island as a

whole. In the northern parts of the island it is the early months of the year, from February to August, that seem to be the favoured breeding period, while in the Batticaloa district of eastern Sri Lanka eggs are apparently laid during every month except the period from November to January.

Nests are situated in a variety of locations, such as on the ground near a tree, under a bush, beneath a fallen log, or among the roots of a tropical tree. Several elevated nesting sites have been reported, such as on the top of a decayed stump about 7 ft from ground, in deserted squirrel nests, and in the old nest of a crow or hawk at about 30 ft off the ground (Beebe, 1918–1922).

The clutch-size is usually of only two eggs, but sometimes three are present, and very rarely four eggs may be laid (Baker 1930). Larger clutches mentioned by Beebe (1918–1922) of up to eight eggs were evidently multiple clutches or artificially supplemented ones.

#### *Incubation and brooding*

The incubation period, at least under artificial conditions, seems to be of 20–21 days. Apparently two or three young are the usual brood size under wild conditions. One brood of seven young has been reported (Beebe 1918–1922), although this brood size might well reflect the efforts of two females.

#### *Growth and development of the young*

Beebe (1918–1922) reported that for the first two

weeks after hatching the young depend on concealment for protection, even though their flight feathers develop rapidly. When the young are about three-quarters grown they begin to escape by fleeing rather than by hiding. The food of the chicks is reported to consist mostly of termites. Two years are required for attainment of full adult plumage and sexual maturity.

#### **Evolutionary history and relationships**

There seems little doubt that this species evolved from a mainland ancestral junglefowl type that probably generally resembled the modern Ceylon junglefowl (Morejohn 1968a), since hybrids between *gallus* and *sonnerati* resemble pure Ceylon junglefowl, especially in the case of females. However, hybrids between the Ceylon and red junglefowl are not fertile when bred *inter se*, although back-crossing to either of the two parental types sometimes results in successful breeding (Beebe 1918–1922).

#### **Status and conservation outlook**

There seems little reason to be concerned about the future of this species, as it survives well under conditions of habitat disturbance and human activities (Henry 1955). Reduced hybrid fertility also probably prevents any significant infusion of red junglefowl genes into the population of this species.

# 7 · Genus *Crossoptilon* Hodgson 1838

The eared pheasants are medium-sized montane pheasants in which sexual dimorphism is virtually lacking and both sexes have variably elongated ear-coverts that form distinct tufts or horns on the sides of the head. The rest of the plumage is also dense, long, and somewhat hairlike, and the tail is variably compressed, with the feathers relatively wide, often disintegrated, and vaulted. The wings are rounded, with the tenth primary much shorter than the ninth, and the fifth or sixth the longest. The tarsus is relatively long, and is spurred in males. Iridescent plumage is virtually lacking in both sexes, but the rectrices are somewhat iridescent in one species. In all species the ear-coverts are white, and white is also often present on the tail-coverts and rectrices. There are 20–24 rectrices, which are somewhat graduated, and the central pair are variably disintegrated, longer than the wing and about twice as long as the outermost pair. The tail moult is phasianine (centripetal). Three species are recognized.

## KEY TO SPECIES AND SUBSPECIES OF *CROSSOPTILON* (after Delacour 1977)

- A. Ear tufts visible above the nape.
  - B. General plumage colour bluish grey: blue eared pheasant.
  - BB. General plumage colour brown and white: brown eared pheasant.
- AA. Ear tufts not visible above the nape: white eared pheasant.
  - B. Breast grey.
    - C. Breast dark grey: Harman's white eared pheasant (*harmani*).
    - CC. Breast pale grey: Dolan's white eared pheasant (*dolani*).
  - BB. Breast white.
    - C. Wings almost pure white: Tibetan white eared pheasant (*drouyni*).
    - CC. Wings grey
      - D. Wings pale grey: Yunnan white eared pheasant (*lichiangense*).
      - DD. Wings dark grey: Szechwan white eared pheasant (*crossoptilon*).

## WHITE EARED PHEASANT<sup>1</sup>

*Crossoptilon crossoptilon* (Hodgson) 1838

Other vernacular names: Tibetan eared pheasant; hoki blanc, faisan oreillard blanc (French); weisser Ohrfasan (German); sharkar (Tibet).

<sup>1</sup> Vulnerable species (King 1981).

## Distribution of species

Eastern Tibet from about long. 91° to 92° E, eastward to western Szechwan, north to southern Tsinghai and south to north-west Yunnan. Sedentary, ranging from the upper limit of the coniferous and mixed forests, and rhododendrons and juniper scrub above the forest, to open grassy hill slopes, occasionally up to the snow line (Vaurie 1965). See map 7.

## Distribution of subspecies (after Vaurie 1965; Wayre 1969)

*Crossoptilon crossoptilon crossoptilon* (Hodgson): Szechwan white eared pheasant. Western Szechwan and adjacent parts of south-east Tibet. Intergrades with *drouyni* and probably with *lichiangense*.

*Crossoptilon crossoptilon lichiangense* Delacour: Yunnan white eared pheasant. North-west Yunnan. Probably intergrades with nominate *crossoptilon*.

*Crossoptilon crossoptilon drouyni* J. Verreaux: Tibetan white eared pheasant. Probably confined to Tibet between the Yangtze and Salween Rivers on the mountains which divide these rivers from the Mekong Valley between lat. 30° and 32° N. Intergrades with *harmani*, producing unstable grey forms.

*Crossoptilon crossoptilon dolani* de Schauensee: Dolan's eared pheasant. Reported from southern Tsinghai. Total range unknown. Probably intergrades with *drouyni*.

*Crossoptilon crossoptilon harmani* Elwes: Harman's eared pheasant. Limited to south-east Tibet north of the main Himalayan axis west to long. 91° E and east to 94° E in the Tsangpo valley, there intergrading with *drouyni*.

## Measurements (Cheng et al. 1978; Vaurie 1972)

	Males		Females	
	Wing	Tail	Wing	Tail
<i>drouynii</i>	300–340	310–365	271–308	280–419
<i>doulani</i>	328	388	295	465
<i>crossoptilon</i>	297–395	—	290–302	—
<i>harmani</i>	272–306	—	265–282	—
<i>lichiangense</i>	318	498–560	290	425–440
All races	272–340	310–560	265–308	280–440





**Map 7.** Distribution of eared pheasants, including blue (Bl), brown (Br), and Dolan's (D), Harman's (H), Szechwan (S), Tibetan (T), and Yunnan (Y) races of white eared pheasant (W).

Cheng *et al.* (1978) reported that three males of *drouyni* ranged from 2350–2750 g, and that seven females ranged from 1400–2050 g, while two males of *lichiangense* were 1017 and 2010 g and two females were 1410 and 1450 g. Felix (1964) reported male weights of 1800–2200 g, and female weights of 1550–1800 g. The eggs average 60 × 42 mm, and their estimated fresh weight is 58.4 g.

**Description (of crossoptilon after Ogilvie-Grant 1893; Delacour 1977)**

*Male*

Top of the head covered with short, curly black feathers; the ear-coverts, unlike the other species of this genus, are only moderately extended, forming white tufts on each side of the head; the whole of the plumage above and below is pure white, shading into grey on the longer wing and upper tail-coverts; primary quills dark brown, secondaries blacker and somewhat glossed with purple. Tail with 20 feathers, purplish bronze towards the base, shading into dark greenish blue and deep purple towards the extremity. Naked parts on the sides of the head scarlet; bill reddish horn; legs red, iris orange-yellow.

*Adult female*

Distinguished from the male by the absence of spurs; the plumage is seemingly identical.

*Juvenile*

Head and upperparts grey with rusty buff shaft-streaks and bands; wings brownish grey vermiculated with dark brown; rump grey mixed with chestnut, tail grey, breast like the back; abdomen buffy grey.

**Identification**

*In the field* (36 in.)

The large size, white body plumage pattern, and drooping darker tail plumage are unique and easily identifiable. The species does not overlap with any of the other eared pheasants, and cannot be confused with other types of pheasant. Calls of eared pheasants include an alarm note that is a sharp, repeated *wrack*, a conversational cackling that terminates on a high *cuco*, *cuco*, and a breeding call often uttered in unison by both sexes and sounding like a repeated *trip-crrra-ah*, becoming progressively louder and

lasting up to about 30 s. Wing-whirring is lacking in the eared pheasants.

#### *In the hand*

This eared pheasant has shorter ear-tufts than the others, and is the only one that is white over most of the head and body, or at least on the head and neck.

#### Geographic variation

Geographic variation is apparently very well marked, but information on distribution is still highly incomplete and the taxonomic situation remains unsettled. The easternmost nominate race is extremely white, while the westernmost race (*harmani*) is dark slaty grey (and sometimes considered a separate species). However, these two extremes are somewhat bridged by the northern race *dolani*, which is pale ashy grey. These three forms, although individually apparently constant, are geographically connected by the highly variable *drouyni*, considered by some to be the result of hybridization among the extreme types. The little-studied race *lichiangense* shows some tendency toward the plumage condition of *drouyni*, but is not known to be in contact with it (Delacour 1977). Cheng *et al.* (1978) indicate that the eastern race *crossoptilon* has been recorded very close to the edge of the range of *auritum*, but there are no known areas of contact between these rather distinctively plumaged types. At present there does not seem to be any clear pattern for understanding the geographic variations in the plumages of this highly variable species.

#### Ecology

##### *Habitats and population densities*

This species typically lives on subalpine forests near the snowline, where there are thickets of rhododendrons present. In Szechwan these forests are of spruce, birch, and holly oak, at 12 000–14 000 ft elevation (Beebe 1918–1922). It typically forages in open grassy hills near rhododendron thickets, and when disturbed runs to the nearest thicket for protection. In elevation it ranges from about 3000 m upwards to snowline, occasionally being recorded as high as 4600 m. In winter it evidently moves into montane subalpine forests, but even then it is rarely observed at elevation of less than 3000 m (Felix 1964).

There do not appear to be any available estimates of population densities of this species, which is currently believed to be rather rare throughout its range.

#### *Competitors and predators*

In a similar manner to the monal, these birds sometimes dig for roots and bulbs, but they also consume an array of above-ground plant materials. Thus, these two types of alpine pheasant probably do not compete strongly, and according to Schäfer (1934) the eared pheasants occupy a somewhat lower altitudinal zone than does the Chinese monal. He listed the blood pheasant as the only other major pheasant species using this subalpine altitudinal zone, and these two species would be unlikely competitors.

Felix (1964) listed a considerable number of probable predators of eared pheasants, including the leopard (*Panthera pardus*), red fox (*Vulpes vulpes*), wild canids (*Canis lupus* and *Cuon alpinus*), marten (*Martes flavigula*), golden eagle (*Aquila chrysaetos*), falcons (*Falco peregrinus* and *F. cherrug*), goshawk (*Accipiter gentilis*) and eagle owl (*Bubo bubo tibetanus*).

#### General biology

##### *Food and foraging behaviour*

Although there is little actual data, it is believed that the foods of this species are mainly bulbs of plants of the lily family, as well as the tuberous stems and bulbs of wild onions, the latter sometimes giving their flesh a strong taste and odour. Digging behaviour is highly developed in the eared pheasants, and their beaks are distinctly sharp and elongated. However, Beebe (1918–1922) stated that a Captain H. Bower reported seeing them feeding on juniper bushes in December and the crop of a bird that he shot there was full of juniper berries. Juniper berries are probably important autumn and winter food sources, according to Felix (1964). In the summer other berries, such as cranberries and strawberries, may also be consumed. Ludlow and Kinnear (1944) reported them feeding on the berries of a mountain ash during autumn.

##### *Movements or migrations*

Apparently there is no marked movement to lower elevations by these birds; Captain Bower observed them in Tibet during mid-January at a height of more than 15 000 ft. Later on the birds were also seen at elevations of as low as 9000 ft. Probably they remain close to the snow-line through the winter, since their white plumage pattern would certainly be most effective in such an environment, and early observers have noted that they are often actually found in the snow (Beebe 1918–1922).

##### *Daily activity and sociality*

These birds show typical daytime activity cycles, feeding early in the morning and until about 10:30



a.m., resting during midday hours, and in the afternoon visiting springs or brooks to drink. At least during the winter period the birds are highly social, and have been seen in flocks numbering as many as 250 birds (Schäfer 1934). More often, however, the birds move about during winter in smaller flocks of about 30 birds (Beebe, 1918–1922).

During much of the rest of the year the birds no doubt break up into much smaller groups, and are said to associate in groups of from two to five pairs (Cheng 1963). There is probably a further dispersion during the actual breeding period as well.

## Social behaviour

### *Mating system and territoriality*

All observers seem agreed that all the eared pheasants are monogamous. This impression is reinforced by the virtual absence of sexual dimorphism in plumage, and in the relatively simple courtship displays typical of the entire genus.

There is no definite information on territoriality, other than the fact that males regularly utter loud calls during the breeding season. These may be heard at distances described as 'up to a mile away' (Ludlow and Kinnear 1944) or even up to 3500 m away (Cheng 1963). The calls are uttered during early morning and late evening, and sound something like *krrah-krrah*. They reportedly are not so full and sharp as are those of the other two species. (Felix 1964).

### *Voice and display*

The male's crowing call is extremely loud, and carries great distances. As in the other eared pheasants, it is typically uttered with the neck and head vertically stretched, and the tail somewhat raised (Fig. 18).

Calling by paired birds is sometimes done in unison, which is perhaps unique among pheasants. The two birds utter a resounding, repeated *trip-crra-ah*, growing louder and louder, and often kept up for 30 s. When foraging they call almost constantly, uttering a mewling, drawn-out cackle that ends on a high note, *cuco, cuco* (Delacour 1977).

The display of eared pheasants is relatively simple. Typically it consists of a sideways parade (waltzing) with the tail cocked, the wing closer to the female lowered to the ground sufficiently far as to scrape the substrate, the tail tilted so that half of it is lowered and the other half raised, the facial wattle distended, and the neck somewhat arched. The male attracts the hen by uttering a repeated *kak* note, presumably the food call, and the female may respond with somewhat similar repeated *krkrkr-krkrkr* notes. Typical tidbitting behaviour, in which the

male holds a bit of food in its beak while attracting the female with calls, also occurs and is apparently characteristic of birds that are forming pair-bonds for the first time. Wing-flapping during display in the eared pheasants is apparently unknown (Felix 1964).

## Reproductive biology

### *Breeding season and nesting*

Rather little is known of nesting by this species in the wild. Ludlow and Kinnear (1944) reported locating three nests in Tibet. One of these contained nine well incubated eggs, and was found under a fallen fir tree on 23 May. Baker (1930) reported a nest from the Arbor Hills of north-east Assam with four eggs, found on 26 May at 11 000–12 000 ft. This nest was located on the ground in deep forest. From this record and sightings of chicks in July and August he judged that May and June are the months during which eggs are laid. Ludlow questioned the Assam origin of this clutch, thinking that it might have instead come from Tibet, but at least the date would seem to be authentic. A group of wild caught birds obtained in 1966 and moved to Tierpark Berlin initially began laying on 30 May (in 1968), but in subsequent years began laying earlier, so that after 11 years the initial laying date occurred as early as 6 May. The entire laying period lasted about two months for these birds, with egg-laying intervals of 2–3 days typical, with rarely a 4-day interval between successive eggs occurring (Grummt 1980).

### *Incubation and brooding*

Most authorities such as Felix (1964) and Grummt (1980) give the incubation period of this species as 24 days. Mallet (1973) stated that the usual period for all three species of eared pheasants is 27–28 days, although Felix indicated that these longer periods are typical only of brown and blue eared pheasants. Mallet also stated that the average clutch consists of up to 15 eggs per pair, presumably reflecting a removal of the eggs as they are laid. Felix (1964) stated that the clutch-size ranges from four to 14 eggs under natural conditions. In spite of the monogamous pair-bonding, all incubation is performed by the female.

### *Growth and development of the young*

Felix (1964) stated that at the time of hatching young eared pheasants weigh approximately 40 g, but by ten days of age they average 85 g, and at 50 days about 600 g, with the weight of females about 50–70 g lower than the males at that age. By the time they are 100 days old males weigh about 1500 g and females about 1350 g, and at 150 days they have





Fig. 18. Postures of blue eared pheasant, including normal (A) and engorged facial skin (B), and calling posture (C). After photographs by the author and John Bayliss.

attained adult weight. Feather growth occurs at a correspondingly fast rate, and adult plumage development is completed by 150–170 days.

Grummt (1980) noted that by the time the birds are 3.5 months old the sexes can be readily distinguished by the presence of a 4–5 mm long tarsal spur in males. Sexual maturity is normally attained at the end of two years, but in some cases hens begin to lay at the age of one year.

#### Evolutionary history and relationships

All three species of eared pheasant are geographic replacement forms, and clearly constitute a super-

species. The white and blue forms are seemingly closely related, with such transitional forms as *harmani* confounding the problem of species limits. Vaurie (1972) believed *harmani* and *crossoptilon* to be borderline cases in speciation, and thought that to treat them simply as subspecies was to obscure the situation.

In any event, it is quite easy to imagine a pattern of possible speciation in this group, with an early separation of ancestral *crossoptilon* stock, and a much more recent separation of *mantchuricum* and *auritum*. *Auritum* and *crossoptilon* are now mostly associated with the montane headwaters of the Yangtze and the Hwang rivers respectively. Cheng

*et al.* (1978) also suggest an early separation of *crossoptilon* stock, and a later division of *auritum* and *mantchuricum*. Delacour (1945) suggested that *crossoptilon* is the least morphologically specialized of the three species, *auritum* is the most highly specialized form, and *mantchuricum* is intermediate. Hybridization combinations within the genus apparently produce fully fertile offspring; natural hybridization with *auritum* has been suggested (Gray 1958) but is apparently unproven.

Relationships of the genus *Crossoptilon* to other pheasants are rather uncertain, although Delacour (1977) suggests that limited hybrid fertility with *Lophura* suggests a fairly close relationship between these genera. He also believed that the genus *Catreus* might be closely related, which seems less likely to me than an affinity with *Lophura*.

### Status and conservation outlook

This species is currently considered vulnerable (King 1981), and is believed to be threatened by forest destruction and excessive hunting. There is a proposed reserve in the Mishmi Hills of northern Assam that should protect the very small Indian range of the species if the sanctuary materializes.

The situation in Tibet is uncertain at present. In China there are a few relatively small sanctuaries that are barely within the probable range of the species (Wang 1980), but most of its known range is unprotected.

There is now an intensive programme in the captive breeding of the white eared pheasant (Mallinson 1979; Grummt 1980), and a stud book has been developed for facilitating the most effective breeding programme (Mallinson and Taynton 1978).

## BLUE EARED PHEASANT

*Crossoptilon auritum* (Pallas) 1811

Other vernacular names: Pallas' eared pheasant, Mongolian eared pheasant; hoki bleu (French); blauer Ohrfasan (German); ho-ki (Chinese).

### *Distribution of species*

Western and central China in the mountains of Inner Mongolia (Ala Shan) west to those of Kansu and eastern Tsinghai, and south to those of north-west Szechwan (region of Sungpan and north of Mowhsien). Sedentary, occurring in coniferous and mixed forests, junipers, and bushy sites on alpine meadows above the forest (Vaurie 1965). See map 7.

### *Distribution of subspecies*

None recognized.

## Measurements

Cheng *et al.* (1978) reported that five males had wing lengths of 285–314 mm, and tail lengths of 477–570 mm, while five females had wing lengths of 283–311 mm and tail lengths of 470–510 mm. The males ranged in weight from 1735–2110 g, and the females from 1820–1880 g. Felix (1964) reported male weights of 1700–2050 g, and female weights of 1450–1750 g. The eggs average 59 × 40 mm, and have an estimated fresh weight of 52.1 g, but 31 fresh eggs averaged 63 g (David Rimlinger, personal communication).

## Description (after Delacour 1977)

### *Male and female*

Top of the head covered with black velvety feathers; lores and sides of forehead, a line on the occiput, chin, throat, and greatly elongated ear-coverts white; entire upper and under plumage bluish grey, most of the webs being disintegrated, loose and hair-like; secondaries dark brown strongly glossed with purple; primaries paler dull brown; tail of 24 feathers, the two central pairs bluish grey with the webs wholly disintegrated, becoming darker and strongly glossed with metallic green, changing at the tip into purple; next few pairs of rectrices less disintegrated, the outer web strongly iridescent greenish and the inner violet purple; the outer five or six pairs of tail feathers with a variable amount of white at base, usually three-quarters of the basal area being of that colour, the distal portion of the feathers metallic purple. Iris yellowish; bill reddish horn; legs crimson. Males normally have considerably longer spurs than females, and larger facial wattles.

### *Juvenile*

As in *mantchuricum*, but darker and greyer. The adult plumage is attained during the first year, and sexual maturity is also usually reached at that time.

## Identification

### *In the field* (38 in.)

This forest-dwelling pheasant of western China is very rare, and is likely to be confused with no other species of the area. It is mostly smoke-grey, with paler areas on the rump and white on the bases of the outer tail feathers. Its calls are very similar to those described for the white eared pheasant. The birds are found in wooded mountain country, and are likely to escape by running uphill and then flying off or dashing into heavy cover.



*In the hand*

Like the brown eared pheasant, this species has long white ear-tufts, but otherwise is much more greyish than brownish in overall body colour, and lacks the white rump typical of that species. It also has 24 rather than 22 tail feathers. Except for the presence of ear-tufts, it might be confused with the *harmani* race of the white eared pheasant, which however has shorter and less highly specialized central tail feathers.

**Ecology***Habitats and population densities*

This species is associated with the sides of rocky mountains, where there are well-wooded slopes and an abundance of undergrowth. In such areas it ranges up to about 10 000 feet elevation. It reputedly is somewhat less dependent upon water than are the other eared pheasants, and has been found well away from any streams, springs, or other sources of fresh water (Beebe 1918–1922). The birds are associated with the borders of alpine pine, juniper, oak, and birch woods, and reportedly never stray out very far onto treeless alpine slopes. However, they may feed out on bushy alpine meadows, returning to tree cover in the evenings to roost. The winter months are spent lower on the mountainsides, and the total altitudinal range of the species is probably between about 8000 and 13 000 ft. Forests in this species' range apparently attain greater heights than do those farther north-east in the range of the brown eared pheasant, and thus the birds are reportedly able to roost somewhat higher in trees (Beebe, 1918–1922).

There are no good estimates of population density for this species.

*Competitors and predators*

Nothing specific seems to have been written on the major predators of this species, but they are probably essentially the same as those mentioned for the white and brown eared pheasants. Likewise, there are probably no significant competitors in this species' range, given its very specialized foraging behaviour.

**General biology***Food and foraging behaviour*

This species is predominantly vegetarian, and Beebe (1918–1922) stated that examination of several crops revealed nothing but the buds and leaves of barberries, stems and roots of young grass, and various kinds of herb. Cheng (1963) reported that the stomachs of nine individuals consisted of 80 per cent

vegetable matter (spruce and *Polygonum* seeds, and the leaves of various trees, sedges and herbs), and 20 per cent of beetles or their larvae.

Foraging is done in small to large groups, with the birds feeding on leaf-buds and the like during late autumn and winter, and during the warmer parts of the year grubbing in the soil for roots, bulbs, and possibly other foods, and using trees only for nocturnal roosting (Beebe 1918–1922).

*Daily activities and sociality*

Like the other eared pheasants, these birds are quite social, and may be seen in groups of considerable size during the non-breeding season. Flock sizes of up to 50 or 60 birds have been reported during such periods. The birds apparently roost singly, however, but within sight of one another, on tree branches from 6 to 12 ft above ground. The middle part of the day is also spent in the shade of the forest trees, with the birds foraging actively during early morning and late afternoon hours (Beebe 1918–1922).

**Social behaviour***Mating system and territoriality*

Like the other eared pheasants, this species is certainly monogamous. Winter flocks seem to be comprised of family groupings, and early in spring these flocks break up into mated pairs. At this time the males begin calling, uttering a call that is loud and hoarse, and described variously as sounding something like *ka-ka.....la!* (Cheng 1963), *krip-krrraah-krrraah!* (Felix 1964), or somewhat like the note of a peacock (Beebe 1918–1922). This call, apparently a challenge call or a mate-attracting call, is given most often soon after sunrise, but sometimes before day-break, and rarely at midday or at other times during the day. Evidently it is rather rarely heard, at least as compared with the calls of the other eared pheasants, and it is reported to repeat its cry only about five or six times altogether (Beebe, 1918–1922). However, Felix (1964) stated that both the blue and the brown eared pheasants call more often and with stronger voices than does the white.

Nothing is known of territorial sizes or territorial defence in this species, although males reportedly fight with one another during the spring season.

*Voice and display*

As noted above, the voice of the male blue eared pheasant is still rather poorly described. Thompson (1976) discussed the voice and especially the displays of the brown and blue eared pheasants in some detail, and stated (*in litt.*) that the courtship postures of the two species were identical and there were also no obvious acoustic differences in the calls, even



when comparing sonograms. Felix (1964) likewise indicates that these two species have very similar calls, at least in the case of males.

Postural displays described for the brown eared pheasant also apply to this species, judging from Thompson's comments (Fig. 18). A detailed comparison of the vocalizations and postural displays of the eared pheasants would be desirable and perhaps of value in assessing evolutionary relationships in the group.

### Reproductive biology

#### *Breeding season and nesting*

Beebe (1918–1922) stated that the eggs are laid during May or early June. Cheng (1963) gives the breeding period as extending from April to June. The nests are located under the cover of trees or shrubs, and are slightly depressed hollows. The clutch-size is reported by Cheng (1963) as ranging from six to 12 eggs, typically eight, and by Felix (1964) as from five to 14 eggs.

#### *Incubation and brooding*

Incubation is performed by the female alone, although the male remains close at hand. Cheng (1963) stated that under conditions of captivity a single female can be stimulated to lay as many as 30 eggs during a year, and he noted that the incubation period ranges from 24 to 28 days. Wayre (1969) noted that at the Pheasant Trust the incubation period has been determined as 28 days. Felix (1964) reported the incubation period as 26 to 28 days, or occasionally as long as 29 days. This would make it the longest incubation period of any of the eared pheasants.

#### *Growth and development of young*

Blue pheasants show the same rather rapid development of the young that occurs in the other eared pheasants. Felix (1964) has provided information on growth of the tail feathers (for blue pheasants specifically) and flight feathers (for eared pheasants in general), as well as some weight changes with age that apparently are applicable to all three species.

### Evolutionary history and relationships

The probable relationships of this species have been discussed in the account of the white eared pheasant, which I believe to be a near relative, even though it shares long ear-tufts and a generally dark plumage pattern with the brown eared pheasant, and vocalizations and display postures are also extremely similar in these two forms, which comprise an allospecies.

### Status and conservation outlook

This is the only one of the three eared pheasants not currently considered endangered or vulnerable, although there is no positive information on which to base a favourable status report. However, there have been several sanctuaries established within the range of this form. Most of these were developed to protect the habitat of the giant panda, which utilizes similar montane forests, and where much deforestation caused by timbering has occurred (Wang 1980). For example, in Szechwan forested areas have been reduced by about 30 per cent since the 1950s, and in all of China the loss of forested areas in the past three decades amounts to at least 24 per cent (Smil 1983).

### BROWN EARED PHEASANT<sup>1</sup>

*Crossoptilon mantchuricum* Swinhoe 1862 (1863)

Other vernacular names: Manchurian eared pheasant; hoki brun, faisan oreillard brun (French); brauner Ohrfasan (German); hoki (Chinese).

#### *Distribution of species*

Northern China in the mountains of southern Chahar in Inner Mongolia (west to perhaps eastern Suiyuan as specimens have been taken about 70 km west of Changkiakow, formerly called Kalgan), northern and north-west Hopeh, and in Shansi south to the region of Yangku in central Shansi. Sedentary, limited to bleak and rocky mountains in shrubs, scrub, coarse grass, or in sites with stands of usually sparse and stunted coniferous or deciduous trees such as birch. (Vaurie 1965). See map 7.

#### *Distribution of subspecies*

None recognized.

### Measurements

Cheng *et al.* (1978) reported that eight males had wing lengths of 270–312 mm and tail lengths of 518–582 mm, while eight females had wing lengths of 265–290 mm and tail lengths of 447–576 mm. The weights of the males ranged from 1650 to 2475 g, and those of the females from 1450 to 2025 g. Felix (1964) reported male weights of 1700–2050 g, and female weights of 1500–1750 g. The eggs average 53 × 39 mm, and have an estimated fresh weight of 44.5 g. However, 58 fresh eggs averaged 60 g. (David Rimlinger, personal communication).

<sup>1</sup> Endangered species (King 1981).

**Description (after Delacour 1977)***Male and Female*

Crown with velvety black feathers; feathers just behind nostrils, chin, throat and the feathers below bare facial area creamy white; the much elongated and stiffened ear-coverts glistening white; neck black, shading gradually into brown on the lower mantle and wings, all the visible portions of the feathers being loose and hairy owing to the abrupt shortening of the barbules and the disappearance of the barbicels on the entire distal half of the web; wing-coverts and secondaries glossed with purple; lower back, rump and upper tail-coverts silvery white; underparts brown; tail of 22 feathers, dull white, but terminal portion brownish black glossed purplish blue; two outer pairs quite compactly webbed, but from the third inwards the outer web showing a disintegration of the barbs, which at the same time become elongated and curved; the two central pairs almost wholly filamentous with a small spatulate and compact tip. In their usual position the central disintegrated pairs of rectrices are raised considerably above the others. The extremities of the four inner pairs are sharply curved downwards. Iris pale reddish brown; bill light reddish horn; legs crimson. Sexual dimorphism is limited to tarsal spur length (usually), and to the relative development of the facial wattles.

*Juvenile*

Mottled brown with buff tips to the feathers, tail short and compact. Adult plumage assumed by about five months.

**Identification***In the field* (40 in.)

The combination of long, white ear-tufts and a body plumage that is brown except for the rump and anterior tail areas which are white, easily serves to identify this species in the field. Like the blue eared pheasants they are forest and forest-edge birds, and are more often heard than seen. Vocalizations are apparently much like those described for the white eared pheasant, but the male's challenge call is even more prolonged. The calls of the blue and brown eared pheasants are apparently almost identical.

*In the hand*

The presence of long white ear-tufts separates this species from all other pheasants except the blue eared pheasant, which is greyish blue on the rump and generally smoke-grey over the rest of the plumage, excepting only the region of the ear-tufts and throat, which are white.

**Ecology***Habitats and population densities*

The brown eared pheasant is a bird of the subalpine forests of birches, oaks and pines, living at elevations of about 1800 to 3500 m. During the summer it reaches the highest levels of the treeline, and during winter is found somewhat lower, although the seasonal differences are not especially large. The oaks and pines of these forests are not very tall, scarcely reaching 5 m, and the birches may be even lower. In Kansu and Schansi provinces the treeline is at approximately 3500 m, and the upper levels of the grass tundra are at about 3800 m (Felix 1964).

There do not appear to be any estimates of population densities available.

*Competitors and predators*

According to Beebe (1918–1922) and Cheng (1963), the natural enemies of this species consist of foxes, wolves, leopards, and various birds of prey. Of the mammals, the foxes are perhaps most abundant, and the leopards next most common. Its defence against raptors is to freeze, but when frightened by mammalian predators it tends to run uphill, or head for the nearest cover.

Like the other eared pheasants, this is primarily a digging species, and it probably has no direct competitors.

**General biology***Food and foraging behaviour*

Foods of the brown eared pheasant are believed to consist of tubers, bulbs, acorns, roots, seeds, leaves, stems, shoots, insects, and earthworms. Beebe (1918–1922) described the crop of a bird as being filled with acorns, and the gizzard with nearly digested acorns. However, he believed that their usual food is tubers, fine rootlets, and insects, and that they obtain their food primarily by digging or grubbing. He observed them foraging in small groups, gathering around a clump of grass and excavating it until it fell down, thus exposing the roots.

*Movements or migrations*

As noted above, the seasonal migrations are probably not very great in this species. Beebe (1918–1922) believed their movements to be less than might be expected, since the birds tend to spend the entire year at median altitudinal levels.

*Daily activities and sociality*

In the course of a day the birds probably move out of wooded roosting areas into the grassy meadows, and returning again each evening. Beebe (1918–1922)



found them in flocks of from 10–30 birds during the winter, and mentioned that in the course of a single day he had observed as many as 33 birds, divided into five separate flocks. Even during the winter flocking period he noted that paired birds were evident, suggesting that permanent pair-bonding is probably present.

#### *Mating system and territoriality*

All observers of these birds in the wild seem agreed that monogamy is the typical mating condition, and perhaps these are among the most strongly monogamous of the pheasants. In the spring the flocks break up into pairs, which disperse and probably establish breeding territories. Beebe (1918–1922) observed the male's challenging call being uttered from members of a flock in early spring, when males would utter it from the ground, a boulder, or the branches of a low oak tree. It is apparently not produced during the summer, autumn or winter, according to him.

#### *Voice and display*

Beebe (1918–1922) stated that during calling the male points the bill almost or straight upward, elevates the tail moderately, and raises the two central plumes well above the others. The call may be written as *Trip-c-r-r-r-r-ah!* and begins low and softly, but increases rapidly in volume and continues at times for as long as 60 s without apparent interruption. In captive birds the call is less well developed, and Beebe noted that the longest duration that he had heard under these conditions was 15 s. Thompson (1976), working with captive birds, noted that male calling in both brown and blue eared pheasants began in January, but rose dramatically in March, and peaked in April, with greatly reduced calling in May, none at all during June and July, and a second calling peak in August, involving both male and females. Thompson noted that during most of the year both sexes call, but that calling in March is almost entirely limited to males. During April courtship and male calling is intense, but calling drops off dramatically after fertilization and egg-laying has begun. The laying cycle in that area (New York) begins in late April or early May, and lasts until the latter part of June.

A major feature of courtship is tidbitting behaviour, and it is the first phase of male courtship. This is typically followed by male postural display, female crouching and head-weaving behaviour, indicating her readiness to mate, and finally mounting and copulation. Tidbitting behaviour in eared pheasants is apparently intermediate between the two extreme types of the male 'freezing over the food' while calling the hen to him, and the other situation

in which the male repeatedly picks up and drops the food before the female. Lateral postural display consists of enlarging the wattles, drooping the primaries on the side nearer the female until they scrape the ground, erecting the rump and tail-covert feathers, and fanning the tail. The head is pulled in toward the chest, and the body and tail are tipped toward the hen. Copulation may occur after a brief chase, or following an invitation posture by the female. After crouching, she weaves her head back and forth in an arc-like manner, with the bill tucked in toward the chest. This almost invariably stimulates mounting by the male, according to Thompson.

### **Reproductive biology**

#### *Breeding season and nesting*

Little is known of nesting in the wild, but according to Beebe (1918–1922) nests are invariably placed in the shelter of pine or birch woods, and consist of a simple hollow in the ground or among dead leaves. The clutch size under natural conditions is reportedly four to 14 eggs, or even up to 22 eggs (Taichun and Rusun 1983). At least in captivity, the eggs are laid every other day.

#### *Incubation and brooding*

The incubation period of the brown eared pheasant is 26 to 27 days, slightly longer than that of the white eared pheasant, and about the same as that of the blue eared. It is performed by the female alone, but the male remains very close, and apparently helps to defend the nest.

#### *Growth and development of the young*

The average hatching weight of the brown eared pheasants is slightly over 40 g; 13 newly hatched young at the San Diego Zoo ranged in weight from 38.5 to 45 g, averaging 41.4 g. By the end of four weeks the average weight was 309 g (D. Rimlinger, *in litt.*). Probably later weight changes follow the pattern described for the white eared pheasant.

At least in captivity, male brown eared pheasants attain their full size, spur development, and breeding ability only in their second year, whereas in the blue eared pheasant this apparently usually occurs in the first year (Thompson 1976). In this species the degree of spur development is variable, and cannot be used as a certain criterion of sex. Likewise, neither tarsal length nor tarsal diameter are totally reliable criteria, although the facial wattles of males are consistently larger both vertically and horizontally in males than in females. Adult males also have slightly lower-pitched calls and average about a half-pound heavier than do females (Thompson 1976).



### **Evolutionary history and relationships**

This has already been discussed in the section on the white eared pheasant.

### **Status and conservation outlook**

The brown eared pheasant is probably more vulnerable than is the white eared pheasant, and it is currently included in the ICBP list of endangered species. Its status in the wild is not known with certainty (Taichun and Rusun 1983). The species may

have been extirpated in Hopei Province by 1931, and its situation elsewhere is generally uncertain or unknown (King 1981). Although a considerable number are currently in captivity, they are nearly all derived from only a few original birds. However, recently there have been importations into England (Wayre 1975), and also some wild-stock birds have been received by the San Diego Zoo. The species is now listed in the first category of protected animals in China, and several reserves have been established for it. Its population now appears to be increasing (Taichun and Rusun 1983).

## 8 · Genus *Lophura* Fleming 1822

The gallopheasants are small to medium-sized tropical to montane pheasants, in which the sexes are strongly dimorphic, the males typically having extensive purplish to greenish iridescence dorsally, blackish underparts, and varying amounts of white on the tail, back and head, often in a vermiculated pattern. There are erectile red or blue velvety wattles around the eyes of males, and similar bare orbital areas in females. The wings are rounded, with the tenth primary shortest, and the fifth and sixth the longest. The tail is graduated and strongly vaulted, usually of 16 rectrices (14 in two species, and up to 32 in males of one species), and the moult is phasianine (centripetal). In two species the tail is unusually short, rounded and flattened, and in three species the central pair of rectrices is shorter than the third pair. In three species both sexes are crested; in four only the male is crested, and three are entirely crestless. Females are brownish to blackish, with varying amounts of spotting or barring. Ten species are recognized here.

### KEY TO SPECIES (AND SUBSPECIES OF MALES) OF *LOPHURA* (in part after Delacour 1977)

- A. Upperparts mostly iridescent bluish, with glossy fringes on feathers.
  - B. Lower back coppery red: crested fireback (male).
    - C. Lower parts bluish-black, with white flank streaks: Vieillot's crested fireback (*rufa*).
    - CC. Lower parts coppery chestnut.
      - D. Sides of body and upper breast black and light rufous: Delacour's crested fireback (*macartneyi*).
      - DD. Sides of body and breast entirely chestnut-rufous.
        - E. Smaller (wing under 280 mm): lesser Bornean crested fireback (*ignita*).
        - EE. Larger (wing over 280 mm): greater Bornean crested fireback (*nobilis*).
  - BB. Lower back blue.
    - C. Not crested.
      - D. Tail black, legs greyish green: Salvadori's pheasant (male).<sup>1</sup>
      - DD. Tail white, legs red: wattled pheasant (male).
    - CC. Crested.
      - D. Crest black: imperial pheasant (male).
- DD. Crest white.
  - E. Mantle white: Swinhoe's pheasant (male).
  - EE. Mantle blue: Edwards' pheasant (male).
- AA. Upperparts not bluish.
  - B. Upperparts brown (females).
    - C. Uncrested.
      - D. Upperparts heavily barred.
        - E. Breast plain rufous: Siamese fireback.
        - EE. Breast mottled with black and buffy: Swinhoe's pheasant.
      - DD. Upperparts not barred.
        - E. Orbital skin blue: wattled pheasant.
        - EE. Orbital skin red.
          - F. Legs grey, a yellowish spot present behind the eye: Salvadori's pheasant.
          - FF. Legs red, no yellowish spot present behind the eye.
            - G. Central rectrices dark brown: Edwards' pheasant.
            - GG. Central rectrices chestnut brown, with black vermiculations: imperial pheasant.
    - CC. Crested.
      - D. Orbital skin blue: crested fireback.
      - DD. Orbital skin red.
        - E. Legs reddish: silver pheasant.
        - EE. Legs grey or brownish: kalij pheasant.
  - BB. Upperparts grey, black, or black and white.
    - C. Uncrested: crestless fireback (both sexes).
      - D. Neck and upper back purplish black: vermiculated with grey: Malay crestless fireback (*erythroptalma*).
      - DD. Neck and upper back light grey, speckled with black: Bornean crestless fireback (*pyronota*).
    - CC. Crested.
      - D. Lower back coppery red: Siamese fireback (male).
      - DD. Lower back black or black and white.
        - E. Legs grey or brown, tail usually under 300 mm and often black, crest usually narrow: kalij pheasant (male).
        - F. Crest white or very pale brown: white-crested kalij (*hamiltoni*).
        - FF. Crest black.
          - G. Plumage entirely black above and below: black kalij (*moffitti*).
          - GG. Plumage variably interspersed with white above or below.
        - H. Upper plumage entirely black.
          - I. Breast black, rump barred with white: black-breasted kalij (*lathamii*).
          - II. Breast whitish or white.
            - J. Rump black: black-backed kalij (*melanota*).

<sup>1</sup> Racial distinctions of males of this species are still undescribed.

- JJ. Rump barred with white: Nepal kalij (*leucomelana*).
- HH. Upper plumage finely marked with black and white.
- I. Breast and underparts entirely black: Williams' kalij (*williamsi*).
- II. Sides of breast with white shaft-streaks.
- J. Central rectrices buffy white on inner web, with black vermiculations: Oates' kalij (*oatesi*).
- JJ. Central rectrices often white, completely lacking vermiculations.
- K. Black barring of upperparts more extensive, becoming generally slightly darker above: Crawford's kalij (*crawfurdi*).
- KK. White parts of dorsal feathers closer together, becoming generally lighter above: lineated kalij (*lineata*).
- EE. Legs red, tail usually over 300 mm and whitish, crest usually full and black: silver pheasant (male).
- F. Upperparts with white predominating over black; ground colour of central rectrices white.
- G. Tail 550–730 mm; hindneck white or nearly so.
- H. Black lines on mantle feathers broken and narrow.
- I. 3–4 black lines on scapulars and wing coverts.
- J. Lateral rectrices entirely black: Szechwan silver pheasant (*omeiensis*).
- JJ. Lateral rectrices white and black: true silver pheasant (*nycthemera*).
- II. 4–5 black lines on scapulars and wing coverts: Fokien silver pheasant (*fokiensis*).
- HH. Black lines on mantle feathers continuous and wavy: western silver pheasant (*occidentalis*).
- GG. Tail 370–620 mm; hindneck often lightly peppered with black.
- H. Hindneck pure white; black barring on tail especially conspicuous.
- I. 4–5 black lines on scapulars and wing-coverts; tail barred but predominantly white: Laos silver pheasant (*beaulieu*).
- II. 2 black lines on scapulars and wing-coverts; tail barring very wide and the lateral rectrices mostly black: Hainan silver pheasant (*whiteheadi*).
- HH. Hindneck peppered with black; tail feather barring not especially conspicuous.
- I. Generally lighter above: Rippon's silver pheasant (*ripponi*).

- II. Generally darker above: Jones' silver pheasant (*jonesi*).
- FF. Upperparts with black predominating over white; central rectrices often becoming buffy.
- G. Larger (wing 260–285 mm); with a relatively long tail (400–480 mm): Ruby Mines silver pheasant (*rufipes*).
- GG. Smaller (wing 225–260 mm); with a shorter tail (295–415 mm).
- H. Neck with a wide white border along sides: Annamese silver pheasant (*annamensis*).
- HH. Neck thickly barred with black and white; no white border along sides.
- I. Tail very short (295–305 mm); and lateral rectrices nearly black; feathers on sides of neck with three concentric black and white lines: Lewis's silver pheasant (*lewisi*).
- II. Tail longer (330–415 mm) and with less black laterally; neck heavily barred with black and white.
- J. Upperparts with slightly narrower black lines, and central rectrices buffy: Boloven silver pheasant (*engelbachi*).
- JJ. Upperparts with slightly broader black lines, and central rectrices pure white: Bel's silver pheasant (*beli*).

## SALVADORI'S PHEASANT

*Lophura inornata* (Salvadori) 1879

Other vernacular names: none in general English use; faisan de Salvadori (French); Salvadori-Fasan-huhn (German).

### *Distribution of species*

The island of Sumatra, between 2000 and 8000 ft, in deep mountain forests. See map 8.

### *Distribution of subspecies*

*Lophura inornata inornata* (Salvadori): southern Salvadori's pheasant. The mountains of the southern half of Sumatra.

*Lophura inornata hoogerwerfi* (Chasen): Atjeh Salvadori's pheasant. Known only from two females collected near Atjeh in north-west Sumatra. The male is unknown.

## Measurements

Beebe (1918–1922) reported that males of *inornata* have wing lengths of 213–227 mm and tail lengths of 152–170 mm, while females have wing lengths of 208–228 mm and tail lengths of 145–150 mm. No weights are available. The eggs average  $2 \times 1.45$  in.





**Map 8.** Distribution of Atjeh (A) and southern (S) races of Salvadori's pheasant, of Bornean (B) and Malay (M) races of crestless fireback (C), and of wattled or Bulwer's pheasant (W).

(50.8 × 36.2 mm), and the estimated fresh weight is 36.7 g.

### Description (after Delacour 1977)

#### *Male (of inornata)*

Head crestless; face wattles scarlet, with a pale yellow-green ring around the eyes and a yellow spot behind; the whole plumage black, the feathers from occiput to tail-coverts and those of the neck, breast, and sides having a broad metallic blue fringe; primaries, secondaries, rectrices, abdomen, and thighs dull black. Tail short and rounded, of 14 feathers, the two central rectrices slightly longer than the second and third. Iris orange-red; bill greenish horny white; legs greenish grey.

#### *Female*

Bright reddish chestnut, the feathers with a broad central streak of buff finely spotted with black, and a pale shaft, producing a mottled appearance; throat pale brown, tail feathers blackish brown. Iris brown or orange; face wattles, legs, and bill colour as in the male.

#### *Immature*

Undescribed.

#### *Juvenile*

A four-week old chick illustrated in *World Pheasant Association Journal* II, 103 was chestnut brown on the wings, scapulars, flanks, upper breast and back, and more buffy on the throat and underbelly, with the chestnut feathers having buffy shaft-stripes and terminal fringes, and these buffy markings even more pronounced on the tips of the secondaries.

### Identification

#### *In the field* (18–23 in.)

This species is limited to Sumatra, and as such is unlikely to be confused with any other pheasant found on that island, such as the bronze-tailed pheasant. The almost entirely black plumage of the male is distinctive, while the female is chestnut brown, with buffy mottling. Vocalizations have not been described for this species, but probably are similar to those of the other *Lophura* forms, with male crow-

ing and wing-whirring prominent among the acoustic signals.

#### *In the hand*

The dark bluish-black male, with no crest and a short tail (to 230 mm) is distinctive; the similar imperial pheasant has a crest, a longer tail (c. 300 mm), and red legs, while the black kalij also has a crest and reddish legs. Females are similar to those of several other *Lophura* species, but are distinctly mottled with buffy underneath, have greenish grey legs, and have a relatively short, rounded and blackish brown tail.

### Geographic variation

Geographic variation in males is still undescribed, but the two female specimens so far known from northern Sumatra (*hoogerwerfi*) are less reddish chestnut and more brownish, with black vermiculations more evident than in the nominate form (Delacour 1977).

### Ecology

#### *Habitats and population densities*

This extremely poorly known pheasant occurs in the montane forests of Sumatra, probably between about 2000 and 8000 ft, at least in the case of the southern subspecies *inornata*. It is said to inhabit flatter ground in the vicinity of mountain peaks, but otherwise its natural history is essentially unknown.

There are no estimates of population density.

### General biology

#### *Food and foraging behaviour*

Nothing is known of this in the wild. In captivity the birds exhibit the same feeding habits as are typical of the firebacks (Howman 1979).

#### *Movements or migrations*

Nothing is known, but movements are likely to be small or absent in this tropical species.

#### *Daily activities and sociality*

There is no information on this.

### Social behaviour

#### *Mating system and territoriality*

It may be presumed that this species has a polygynous mating system similar to that of its near relatives, but this is only speculation.

#### *Voice and display*

According to Kenneth Fink (personal communication), the male's display consists of a rather simple wing-whirring performed while standing in a stiff and erect tip-toe posture (Fig.19). The male's yellow eye-ring and similarly coloured wattle spot behind the eye become very conspicuous at this time, and the wattle is somewhat enlarged. In spring the males utter a series of clucking calls in early morning, but not before or after the wing whirring display. Presumably the males perform a tidbitting display, and very probably a lateral waltzing display as well, but there are no descriptions of these in the literature.

### Reproductive biology

#### *Breeding season and nesting*

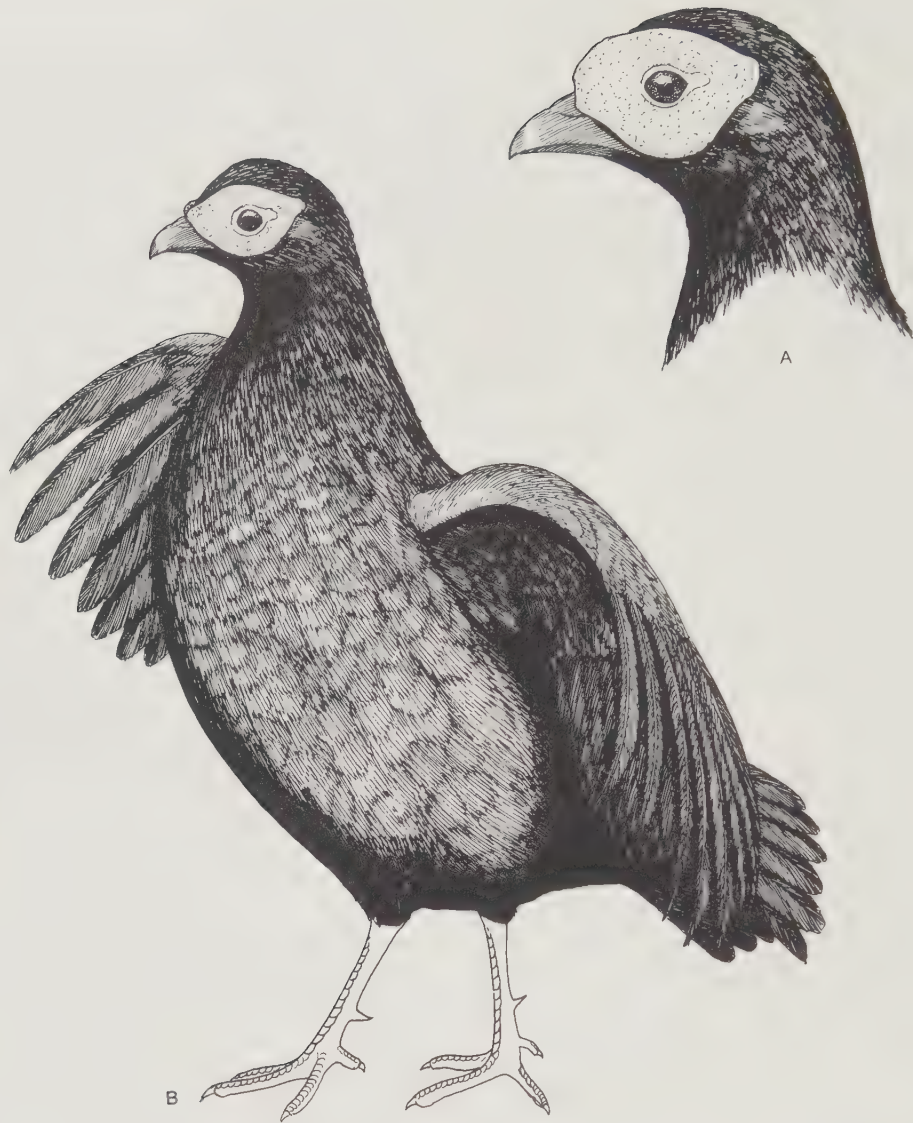
Nothing is known of the breeding season in the wild. In captivity the birds have recently bred in France (Houpert and Lastere 1977), laying two eggs in late June after having been released into an aviary early in May. One egg had been dropped earlier in April, while the birds were still in their winter quarters, apparently having been laid from the elevated perch and broken on the ground below. The female nested in an elevated nesting basket placed close to the pair's perching place, not utilizing various artificial nests at ground level. Two apparently unincubated eggs were found on 20 June, one of which hatched on 12 July, after an artificial incubation period of 22 days.

#### *Incubation and brooding*

Other than the account just mentioned, there has been only one other published description of breeding, that of Charles Sivel (Delacour 1977). He first bred the species in March of 1977. He found the clutch to be of two eggs, and confirmed an incubation period of 22 days (under incubation conditions of 99.5 °F) for this species.

#### *Growth and development of the young*

Houpert and Lastere (1977) reported that rearing the chick they hatched caused no problems, and it readily fed on turkey starter crumbs, with mealworms added, and chopped hard-boiled egg yolk also given occasionally. After two months it was eating commercial rearing pellets, and at four months was on adult rations of various grains plus rearing pellets. Sivel noted (*World Pheasant Association Journal* 2,103) that the chicks required beak-feeding, and initially took small mealworms. Later they began to eat a mixture of game bird crumbs,



**Fig. 19.** Postures of male Salvadori's pheasant, including facial skin engorgement (A) and wing-flapping (B). After photographs by Ken Fink.

sunflower meat, milo and millet, supplemented by mealworms.

#### **Evolutionary history and relationships**

This is a highly generalized species of *Lophura*; Delacour (1977) was struck by its 'primitive aspect'. It seems most likely to be a fairly close relative of the imperial and Edwards' pheasants and also the Malay crestless fireback; Delacour considered it to be a transitional form between *edwardsi* and *erythroptalma*. The latter makes more zoogeographic sense, but female plumage patterns are more sugges-

tive of relationships with the Edwards' and imperial pheasants.

#### **Status and conservation outlook**

There is no information of the status of this species in the wild. There is only one established national park in Sumatra; Gunung Leuser, of some 800 000 ha, and it is known to have a population of this species within it. Two other proposed national parks of about 1.5 million ha and 356 000 ha, are also located in the uplands of Sumatra, and probably also support the species, but detailed information on them is not yet available (Sumardja 1981).





Map 9. Distribution of Edwards' (E), imperial (I), and Swinhoe's (Sw) pheasants, and of Siamese fireback (S).

### IMPERIAL PHEASANT<sup>1</sup>

*Lophura imperialis* (Delacour and Jabouille 1925)

Other vernacular names: none in general English use; faisan impérial (French); Kaiserfasan (German).

#### *Distribution of species*

Mountains of Annam Range, Donghoi Province, southward to northern Quangtri, central Vietnam, and adjoining part of Laos. See map 9.

#### *Distribution of subspecies*

None recognized.

### Measurements

The wing lengths of two males were 248 and 252 mm, and their tail lengths were 241 and 300 mm.

Four females had wing lengths averaging 213 mm, (194–234 mm), and tail lengths averaging 214 mm (176–290 mm); (Delacour 1977 and personal observations). Weights are not available. The average egg size is 53×40 mm, and the estimated fresh weight is 46.8 g.

### Description (after Delacour 1977)

#### *Male*

Entirely dark blue, the body feathers being black with a broad blue fringe; those of the lower back and rump, the wing- and tail-coverts are deep black and have bright metallic blue borders; the head has a rather short but pointed blue-black crest; central rectrices are long, pointed, slightly curved and inconspicuously spotted with brown, as well as the back and wings. Face wattles scarlet with two lobes; legs crimson. Iris reddish orange; bill pale yellowish green, the base blackish.

<sup>1</sup> Vulnerable species (King 1981).

*Female*

No real crest but the feathers of the crown are long and often erected; head light greyish brown, the cheeks, chin and throat paler; upperparts chestnut brown, with pale shafts and inconspicuous black vermiculations, upper tail-coverts bright chestnut; central rectrices chestnut brown, vermiculated with black, the others black; primaries black vermiculated with light grey along the shaft; secondaries black with a chestnut border; underparts pale greyish-chestnut, sometimes slightly mottled. Soft parts as in the male.

*First-year male*

Dark brown with some back feathers showing a bluish border; tail, crest, and spurs short. Adult plumage and sexual maturity is attained before the bird is two years old.

*Immature*

Like the female, but more olive-brown with minute black vermiculations, a little stronger on the back and coarser on the underparts; subterminal black markings to the mantle feathers and wing-coverts; tail light chestnut.

**Identification***In the field* (24–30 in.)

This rare pheasant is limited to northern Vietnam, where it might possibly be confused with the Edwards' pheasant, which occurs somewhat farther south. The entirely dark blackish appearance of the male, with its short and dark-coloured crest, is distinctive. The species' vocalizations are essentially undescribed, but the male has a conspicuous wing-whirring display. Otherwise it has been described as rather silent. Females are extremely similar to those of the Edwards' pheasant, and probably cannot be safely distinguished in the field.

*In the hand*

Male imperial pheasants are unique in their possession of an entirely glossy black plumage, a short, full crest, and a relatively short tail. The very similar Salvadori's pheasant lacks a definite crest and has greenish grey rather than reddish legs. Females are very similar to those of the Edwards' pheasant, but in the imperial pheasant the plumage is more distinctly marked with buffy vermiculations and paler feather edges, producing a slightly 'scaly' appearance, and the posterior head feathers are longer and more crest-like, a condition most obvious on living birds.

**Ecology***Habitats and population densities*

This species is believed to be entirely limited to the rugged limestone mountains of Donghoi and northern Quangtri provinces of Vietnam, and adjoining areas of Laos, where the birds occur in nearly impenetrable forest and brush (Delacour and Jabouille 1925). This area is near the former demarcation line between North and South Vietnam, and this area received heavy defoliation applications, so its habitats have probably been seriously affected (King 1981).

There are no estimates of population densities.

*Competitors and predators*

Apparently this species does not overlap with the closely related Edwards' pheasant, but perhaps does occur in close proximity to such species as the silver pheasant and the Siamese fireback, both of which potentially might be competitors.

The predators of this species have not been identified, but probably consist of the usual predatory mammals found in the jungles of south-east Asia, and perhaps some forest-adapted raptors.

**General biology***Food and foraging behaviour*

There is no information on this in the wild. In captivity the birds are typical *Lophura* species, eating a variety of plant and animal materials, but seemingly favouring higher protein diets, supplemented by grains, fruits, and green materials (Roles 1981).

*Movements or migrations* Nothing is known of these, but probably the birds are highly sedentary, given the minor seasonal temperature variations in this area.

*Daily activities and sociality* No information is available on wild birds. In captivity the birds appear to be much like other *Lophura* types in these traits.

**Social behaviour***Mating system and territoriality*

There is no information on this in the wild. According to Delacour the birds are rather silent, so it is unlikely that large territories are defended.

*Voice and display*

Surprisingly little has been written on this. Delacour (1977) stated that the male's courtship is the simple type typical of the kalij group, with wing-

whirring and lateral display. No crowing behaviour has been mentioned, nor has tidbitting behaviour been described, but it is likely that both do occur.

## Reproductive biology

### *Breeding season and nesting*

There is no information from the wild on these topics. In captivity, the initially caught female began laying in April. Nesting is on the ground, rather than in elevated locations, in pockets of dense vegetation. The clutch-size in captivity is of five to seven eggs, according to Delacour (1977).

### *Incubation and brooding*

The incubation period, at least under captive breeding conditions, is 25 days (Delacour 1977).

### *Growth and development of the young*

There is little specific information on this, but apparently the young were reared by Delacour fairly easily, being fed on custard and insects. Over the years, the breeding success gradually declined, probably as a result of the high degree of inbreeding. The original male survived from its capture in 1923 to 1940, and was in perfect condition at that time, when World War II brought an end to Cleres. Gradually during that war the captive stock declined, and by 1959 it had reached a critical point. At that time Carpentier *et al.* (1975) began to attempt a restoration project, using a single male imperial and a female silver pheasant for breeding. In 1964 and 1965 a considerable number of hybrids were reared, and to these birds were added another pure-bred male and a male that was in part (one eighth) of Edwards' pheasant ancestry. Some of the hybrids produced from these matings by 1968 produced birds quite close to the imperial pheasant in phenotype.

In addition to these efforts, experiments carried out in Holland using progeny of crosses between the imperial pheasant and the Nepal kalij pheasant have produced birds that also are very close to the imperial pheasant phenotype. Like the imperial pheasant, these birds take almost two years to attain full adult plumage and sexual maturity (Roles 1981). Fertile hybrids have also been reported with the Swinhoe's pheasant, as well as with the Edwards' pheasant (Delacour 1977). There were still about 24 birds in captive collections as of 1982, but most or all of these are of varying degrees of hybrid origin.

## Evolutionary history and relationships

The similar appearance and geographic affinities of the imperial and Edwards' pheasant make it apparent that they share a fairly recent common ancestry,

and have seemingly barely attained the level of species distinction. They are also obviously rather closely related to the Salvadori's pheasant and, somewhat more remotely, to the rest of the typical kalij group.

## Status and conservation outlook

Nothing is known of the current status of the imperial pheasant in Vietnam, but it was certainly greatly affected by habitat changes during the Vietnam war. Maintenance of captive stock is greatly hampered by low fertility and possibly also the infusion of foreign genes from related species.

## EDWARDS' PHEASANT<sup>1</sup>

*Lophura edwardsi* (Oustalet) 1896

Other vernacular names: Annam kaleege; faisan de Edwards (French); Edwards-Fasan (German).

### *Distribution of species*

Eastern slopes of the mountains of central Vietnam from Quangtri to Faifoo, in damp mountain forests from sea level to 3000 ft. See map 9.

### *Distribution of subspecies*

None recognized.

## Measurements

Delacour (1977) reported that males have wing lengths of 220–240 mm, and tail lengths of 240–260 mm, while females have wing lengths of 210–220 mm and tail lengths of 200–220 mm. A male weighed 1115 g, and a female 1050 g (Wolfgang Grummt, personal communication). The eggs average 45×36 mm, and have an estimated fresh weight of 32.2 g.

## Description (after Delacour 1977)

### *Male*

A short white crest, some feathers mixed with black, rest of the body plumage dark blue, the feathers having large, silky blue fringes; lower back, rump, tail-coverts, and scapulars with subterminal deep black and terminal metallic blue borders; wing-coverts similar, but the outer border green; secondaries dark blue; primaries brownish black; tail blue, comparatively short and straight, the central pair of rectrices rounded, not pointed nor longer than the second and third. Iris reddish brown; face

<sup>1</sup> Vulnerable species (King 1981).



wattles scarlet with two large lobes above and below; bill whitish green, blackish at base; legs crimson.

#### *Female*

No apparent crest; general colour chestnut brown, the head and neck greyer, the mantle redder; three central pairs of rectrices and primaries dark brown, the others black; the whole plumage very finely and inconspicuously vermiculated with black, and the shafts of the feathers light brown. Iris hazel brown; bill horny brown; legs scarlet.

#### *Juvenile*

Head and neck greyish brown, the throat pale fulvous; body feathers chestnut brown, finely vermiculated with black; feathers of mantle with two subterminal dark spots; wing-coverts greyish black at base, chestnut streaked with black near the end with a blackish V-shaped subterminal marking. Young males assume their adult plumage in the first year, but have slightly less brilliant colouration than older males. Initial breeding usually occurs in the second year of life.

### **Identification**

#### *In the field* (23–25 in.)

This species is endemic to central Vietnam, and is likely to be confused only with the even rarer imperial pheasant, occurring farther north in Vietnam. Males of both species are very similar, but the Edwards' pheasant has a white crown and crest, whereas the imperial pheasant is entirely dark bluish black. In both species the legs and facial skin are red. The male's vocalizations are essentially undescribed, but males are said to be rather silent except for a wing-whirring display. Females of the two species cannot be safely distinguished in the field.

#### *In the hand*

This is the only species of *Lophura* in which the males are entirely bluish black except for a white crown and crest. The Swinhoe's pheasant is similar, except that it also has white on the mantle and central tail feathers. Females very closely resemble those of the female imperial pheasant, but have slightly longer tails (at least 200 mm), and additionally their underparts are not noticeably paler and more greyish than their upperparts. Furthermore, the dark brown body plumage is only slightly and finely vermiculated with black, rather than being noticeably vermiculated with black and buff as is true of the imperial pheasant. The female Salvadori's pheasant is also very similar, but has

more buffy spotting underneath, has a considerably shorter (to 150 mm) tail, and greenish grey legs. The female wattled pheasant is also similar, but has blue facial skin.

### **Ecology**

#### *Habitats and population densities*

This species is found in the low to moderate altitude and extremely moist forest of the eastern slopes of the mountain of central Vietnam (Assam), occurring from sea level up to about 3000 ft. They are associated with very thick undergrowth and liana-covered hillsides, and have scarcely been observed by biologists in the wild (Delacour 1977). Much of this area was extensively sprayed by defoliants during the Vietnam war, and its effects on pheasant and other bird populations remains unknown (King 1981).

There are no estimates of their population density.

#### *Competitors and predators*

Delacour (1977) stated that this species occurs in association with grey peacock pheasants, green peafowls, red junglefowls, crested argus, and Siamese firebacks. Of these perhaps the congeneric fireback is the most likely competitor, although most of the others mentioned probably also feed on similar foods.

Nothing has been written on probable predators, which probably include several jungle-adapted felids and mustelids, and various large raptors.

### **General biology**

#### *Food and foraging behaviour*

Although not studied under natural conditions, Edwards' pheasants in captivity seem to be typical *Lophura*, eating the usual mixture of grains, mash, and green foods (Delacour 1977).

#### *Daily activities and sociality*

There is no specific information on this, but little reason to believe that it differs from the situation in other forest-dwelling pheasants, with morning and late afternoon foraging and nocturnal roosting in trees. These birds are unlikely to be highly social, since that is also atypical of forest-dwelling pheasants.

### **Social behaviour**

#### *Mating system and territoriality*

No information is available for wild birds. In captivity they seem to be typical *Lophura* species, and do not appear to form definite pair-bonds.

Territorial behaviour is unknown, but the males have been reported to exhibit crowing behaviour (repeated *chuck* calls) in the spring (Ken Fink *in litt.*)

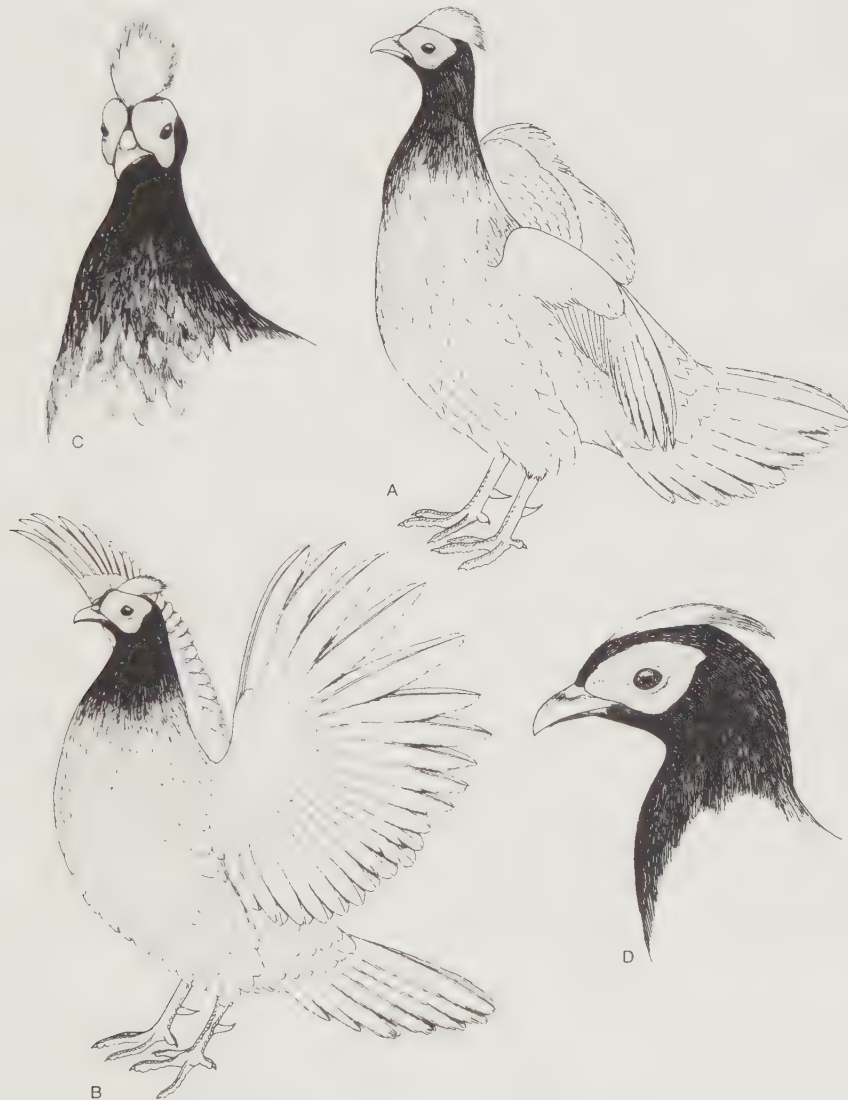
#### *Voice and display*

According to Delacour (1977), males of this species simply 'whirr their wings, raise their crests, and fluff the feathers of the back in the usual simple way of the kalijs'. Photographs of this display by John Bayliss (Fig. 20) agree with this general description, although more details would be useful. Calling is apparently not associated with wing-whirring.

#### **Reproductive biology**

##### *Breeding season and nesting*

The breeding season in the wild is unknown. In captivity, the birds are among the earliest to lay, and the first female ever brought into captivity (in 1924) laid its first egg under captive conditions in the following year on 23 March. Four more eggs were laid at two-day intervals, and ten days later another clutch of five eggs was begun. A third clutch of four eggs followed this, but these proved infertile. A second pair laid two eggs in late April and early May. At the same time a male was hybridized with a female Swinhoe's pheasant, and the hybrids proved to be



**Fig. 20.** Postures of male Edwards' pheasant, including two stages of wing-flapping (A and B), crest-raising (C), and normal resting posture (D). After photographs by John Bayliss.

fertile (Delacour 1977). More recently, hybridization has also occurred with silver pheasants (Lovel 1977). In general, the clutch-size in captivity seems to range from four to seven eggs, and the eggs have an unusually short incubation period of only 21–22 days. The nest and clutch-size has not yet been described for wild birds.

#### *Growth and development of the young*

Reportedly, the young of this species are relatively easy to rear, and in 1976, 150 young birds were bred by only 20 breeders. Infertility is now fairly common, and embryos also often fail to hatch (Lovel 1977), presumably as a reflection of the high amount of inbreeding that has occurred since the original importations.

#### **Evolutionary history and relationships**

There can be little doubt that the Edwards' pheasant and imperial pheasant are extremely closely related, and one might almost argue that they should be considered conspecific. However, besides the minor differences in crest and wing-covert colouration, the imperial pheasant apparently matures only when two years old, but the Edwards' pheasant matures its first year. The ecological significance of the delayed maturity in the imperial pheasant is not at all clear, and perhaps these differences are not so hard and fast as they would seem. Both species appear to be derived from an ancestral *Lophura* type of south-east Asia that has only locally survived in the Vietnam mountains and, in Sumatra, in the closely related form *inornata*.

#### **Status and conservation outlook**

This species is presently considered vulnerable (King 1981), although the most recent available reports from Vietnam (in 1975) suggest that the birds may be thriving in the secondary growth resulting from forest destruction during the Vietnam war (King 1981). The recent establishment of a stud book (Lovel 1977) might be helpful in controlling the rate of further inbreeding of captive stocks, which are unlikely to be supplemented by any more wild stock in the near future.

#### **KALIJ**

*Lophura leucomelana* (Latham) 1790

Other vernacular names: kaleej pheasant; faisán leucomèle (French); Schwarzfasan (German).

#### *Distribution of species*

Himalayas, from the foothills (but usually from about 6000 ft) to about 12 000 ft, from about the Indus to north-east Assam, southward to Burma and neighbouring western Thailand. Sedentary, but moves altitudinally to some extent with the season. Occurs in dense undergrowth of evergreen and deciduous forests, near streams and often in thickly overgrown ravines, also bamboos, canes, or other thickets, and undergrowth of secondary forest or dense scrub on abandoned plantations (Vaurie 1965). See map 10.

*Distribution of subspecies* (after Vaurie 1965; Wayre 1969; Ripley 1961)

*Lophura leucomelana hamiltoni* (J. E. Gray): white-crested kalij. Widespread in the western Himalayas from the Indus and northern N.W. Frontier Province, east through the Punjab to western Nepal, from 900 to 10 000 ft; from tropical moist deciduous and sal forest to the dry temperate zone.

*Lophura leucomelana leucomelana* (Latham): Nepal kalij. Limited to Nepal, probably from the Gogra to the Arun Kosi Rivers; in sal, subtropical pine and moist temperate forest. Also introduced in the Hawaiian Islands (Hawaii) in 1962, where now expanding in range (Pratt 1975).

*Lophura leucomelana melanota* (Hutton): black-backed kalij. Occurs from Darjeeling, Sikkim and western Bhutan to the Sankosh River, from the foothills at 350 to 9000 ft; in tropical semi-evergreen, subtropical wet, and wet temperate forest.

*Lophura leucomelana moffitti* (Hachisuka): black kalij. Range unknown. Known only from captive specimens of uncertain origin. Exported from Calcutta occasionally from 1934 to as late as 1949. May possibly occur in south-west Assam or the Bangladesh hills.

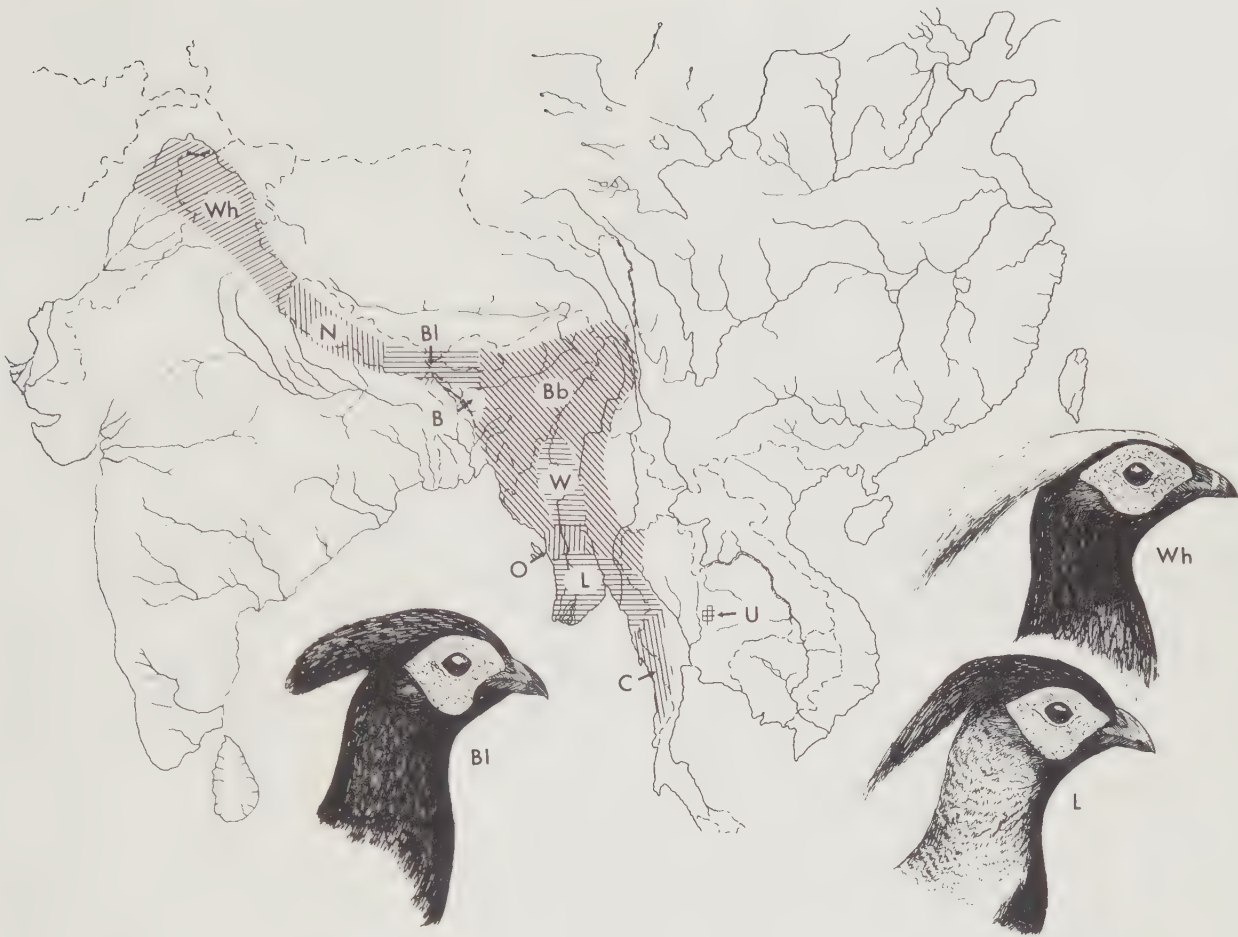
*Lophura leucomelana lathamii* (J. E. Gray): black breasted kalij. Widespread, in eastern Bhutan, Assam hills north of the Brahmaputra, Garo, Khasia, Cachar, Naga and Patkoi Hills, Sylhet, Manipur and east to Burma, from 300 to 5000 ft; in evergreen, deciduous, and moist temperate forest.

*Lophura leucomelana williamsi* (Oates): Williams' kalij. Limited to western Burma, south to the Chin Hills and central Burma. Intergrades with *lathamii* and *oatesi*.

*Lophura leucomelana oatesi* (Ogilvie-Grant): Oates' kalij. Limited to southern Burma in the Arrakan Yomas north to about lat. 20° N. Intergrades with *lathamii* in the west and *williamsi* in the east.

*Lophura leucomelana lineata* (Vigors): lineated kalij. Limited to southern Burma in Pegu Yomas,





**Map 10.** Distribution of black (B), black-backed (Bl), black-breasted (Bb), Crawfurd's (C), lineated (L), Nepal (N), Oates' (O), Williams' (W) and white-crested (Wh) races of kalij. The racial attribution of birds from eastern Laos is uncertain (U).

northern Tenasserim and north-west Thailand. Intergrades with *crawfurdi*.

*Lophura leucomelana crawfurdi* (L. E. Gray): Crawfurd's kalij. Limited to southern Burma in Tenasserim and western Thailand from lat. 12° N to 16° N approximately. Intergrades with *lineata* in the north.

#### Measurements (various sources, including personal observations)

Ali and Ripley (1978) reported that males of *leucomelana* weigh from 1 $\frac{3}{4}$  lb to 2 $\frac{1}{2}$  lb. (c. 795–1140 g), and that males of *melanota* weigh from 2 lb 6 oz to 2 $\frac{3}{4}$  lb (c. 1080–1150 g), while females weigh from 1 lb 14 oz to 2 $\frac{1}{4}$  lb (c. 848–925 g). Baker (1928) gave the weights of *hamiltoni* as 2 lb 6 oz in males and 1 $\frac{1}{4}$ –2 $\frac{1}{4}$  lb in females, those of *leucomelana* as 1 $\frac{3}{4}$ –2 $\frac{1}{2}$  lb in males, and those of *melanota* as 2 lb 6 oz–2 $\frac{3}{4}$  lb in males and 1 lb 14 oz–2 $\frac{1}{4}$  lb in females. The eggs of *melanota* average 48.7 × 37.3 mm and have an estimated fresh weight of 37.4 g.

	Males		Females	
	Wing	Tail	Wing	Tail
<i>hamiltoni</i>	225–250	230–250	203–215	205–215
<i>leucomelana</i>	216–233	250–305	198–211	—
<i>melanota</i>	215–240	238–300	211–222	186–207
<i>lathamii</i>	210–240	210–245	205–230	190–225
<i>williamsi</i>	223–247	245–265	206–220	191–202
<i>oatesi</i>	235–295	275–300	205–225	201–234
<i>lineata</i>	220–260	230–345	203–235	220–235
<i>crawfurdi</i>	240–250	270–290	230	238
All races	210–295	210–345	198–235	186–238

#### Description (of *lineata*, after Ogilvie-Grant 1893)

##### Adult male

Top of the head and elongate crest black, glossed with purplish blue; back and sides of the neck, back, rump, upper tail-coverts, lesser and median wing-

coverts, and scapulars finely vermiculated with alternate black and white lines running chiefly across the feathers; primaries and their coverts blackish brown; secondaries and secondary coverts black, all with obliquely-irregular white lines; chin, throat, forepart of neck, and rest of underparts black with a slight blue gloss; the feathers on the sides of the breast always have white shaft-stripes. Middle pair of tail feathers dirty white, more or less vermiculated with black on the outer web except at the extremity; rest of the feathers obliquely vermiculated with black and white, the black gradually increasing and the white diminishing on each successive feather, so that the outer pair are black, obliquely vermiculated with white. Bill bluish or brownish horny; facial skin blood-red; legs and feet fleshy brown; iris brownish yellow.

#### *Adult female*

Top of the head and crest tinged with rufous, rest of the upperparts olive-brown; most of the feathers of the mantle with V-shaped white marks narrowly edged with black; inner webs of the primaries and secondaries brown; the outer webs of the latter slightly mottled with whitish buff along the margin; sides of the neck with triangular white spots; chin, throat, and forepart of neck whitish; rest of the underparts brownish chestnut, each feather with a pointed white shaft-stripe margined with black. Middle pair of tail feathers buff, mottled on the outer web and also slightly on the inner with black; the six outer pairs are reddish brown, with wide irregular white bars mottled and widely margined with black; the second pair have the basal two-thirds like the outer pairs, and the terminal third buff mottled with black like the middle pair. Soft parts as in male but duller.

#### *Immature male*

Wing-coverts and scapulars intermixed with pale olive-brown feathers, greyish towards the tip and vermiculated with black; some of the black feathers of the breast are mixed with brown, and the white shaft-stripes are mostly confined to the feathers of the sides and flanks. As in other subspecies, young males assume their adult plumage during the first year.

#### **Identification**

##### *In the field* (20–29 in.)

Males of the many races of this species are extremely variable in appearance, but in areas where possible confusion with the silver pheasant exists they can usually be distinguished safely by their shorter tails, which are often largely or entirely

black, their greyish rather than reddish legs, and a thinner occipital crest. Females cannot be safely distinguished from silver pheasants in the field. The males have harsh crowing calls that are uttered during the breeding season, a drumming sound that is produced by wing-whirring, and the species' alarm call is a repeated *whoop-keet-keet*. The birds are generally associated with tropical to temperate forests under 6000 ft, but sometimes occur up to 10 000 ft in the Himalayas.

##### *In the hand*

Males are likely to be confused only with male silver pheasants, but have shorter (under 300 mm) central tail feathers that only rarely are entirely white, and often are entirely glossy black. The darkest races (e.g. *moffitti*) approach the Edwards' pheasant in appearance, but lack white crests and usually have longer (often over 260 mm) and more pointed tails, as well as less greenish fringes on the upper wing-coverts. Females are similar to those of several other *Lophura* species, but their more greyish legs separate them from female silver pheasants, while their crested condition separates them from most other *Lophura* species.

#### **Geographic variation**

Geographic variation is extremely pronounced among males, and is further confused locally by hybridization with the silver pheasant at the eastern edges of the kalij pheasant's range. In the Himalayas the male variation is clinal in some characters. Thus, the brown borders on the back feathers become less conspicuous, and the width of the white tips of the rump and upper tail-covert feathers decreases from west to east, with the white tips disappearing in *melanota*, but reappearing farther east in *lathamii*. The length of the crest and also of the lanceolate feathers of the underparts also decreases from west to east, and the gloss of the upperparts increases and becomes more purplish from west to east (Vaurie 1965). There is no clear-cut trend in tail-length or wing-length characteristics among the races of this species, with both showing a high range of variability. However, the central tail feathers, which are black in the Himalayan races, become white to buffy white in the more southerly and lowland-adapted forms (*williamsi*, *oatesi*, *lineata* and *crawfurdi*). The feathers of the upperparts and outer tail feathers likewise show increasing amounts of barring or vermiculations, while those of the underparts become generally blackish, with the white edging and shaft-streaking diminishing. However, the darkest of all races is *moffitti*, which lacks the white edging on the rump feathers as occurs in the east-



wardly adjoining race *lathamii*, as well as the pale edging and streaking of the flanks as found in the races occurring to the north and west. Likewise the southernmost form (*crawfurdii*) has the most reddish legs, approaching those of the silver pheasants, although there is no known contact and opportunities for local hybridization between these forms (Delacour 1977). Variations in the females are similar to those of the males.

## Ecology

### *Habitats and population densities*

The nine subspecies of kalij pheasants recognized by Delacour occur over an extremely wide range of habitats and elevations, from nearly sea level to at least 11 000 ft, and in a variety of tropical to montane forest habitats. Beginning in the western edge of the species' range, the white-crested kalij occurs from 1200 to 11 000 ft, but is most common between 3000 and 7000 ft, and may be found lower in winter and higher in summer. In these medium elevations the dominant trees are pines (mainly *Pinus longifolia*), especially below 6000 ft, while from about 5000 to 9000 ft oak forests (especially *Quercus incana*) predominate. The Nepal kalij is most common between 4000 and 6000 ft, but ranges to 10 000 ft, and occurs in similar montane forest habitats. The black-backed kalij is most common between 2000 and 5000 ft, but ranges to 9000 ft, and occurs in subtropical wet and temperate forests receiving up to 126 in. of precipitation annually. The black-breasted kalij is most abundant from the low plains of about 1000 to 3000 ft, but sometimes ranges up to at least 6000 ft, and is associated with semi-tropical wet, evergreen forests and mixed deciduous-evergreen forests receiving from less than 90 to more than 100 in. of precipitation (Bump and Bohl 1961; Ali and Ripley 1978).

The more easterly forms of kalijs are also diverse in their relatively tropical habitats. The Williams' kalij occurs mainly between 1000 and 6000 ft in bamboo jungles as well as in open forests mixed with bamboo. The Oates' kalij also occurs in similar brush, on bamboo and grass-covered slopes of moderate elevations of from about 1500 to 3000 ft. Crawfurd's and lineated kalijs are generally found in low elevation forests of tropical to subtropical climate, and occur in rocky ravines, brush-covered slopes, and riverine bamboo thickets, and particularly bamboo jungles between 2000 and 3000 ft, sometimes extending into lighter evergreen or deciduous forests at somewhat higher elevations (Baker 1930; Delacour 1977).

One of the few density estimates was provided by

Fleming (1976), who found 19 birds in an area of 0.25 square miles in Uttar Pradesh, India.

### *Competitors and predators*

Bump and Bohl (1961) reported that kalij pheasants do not seem to be very susceptible to predators, and they were unable to locate any instances of predation. Civet cats are known egg predators (Baker 1935). Competitors include the red junglefowl, males of which have at times been reported to attack kalij pheasants, and seemingly are regularly beaten or even killed by the junglefowl (Baker 1930).

## General biology

### *Food and feeding behaviour*

Kalij pheasants are surprisingly omnivorous, eating almost anything from bamboo seeds to small snakes and lizards, but have a special fondness for termites, figs, bamboo seeds, forest yams, and the roots of a ginger-like plant (Baker 1930). Bump and Bohl (1961) also report a wide variety of foods taken, including seeds, berries, grass, herbs, shrubs, roots, and a diversity of insects, worms, and larvae. Ali and Ripley (1978) mention such specific items as acorns, the ripe fruits of *Pyrus* and *Rosa*, green stems of *Viscum*, pods of *Desmodium*, bulbils of *Dioscorea*, and ripe seeds of *Nyctanthes*, as well as the tops of nettles and ferns, and the fruits of *Polygonum* and *Rubus*.

Foraging is apparently done in rather small groups, perhaps pairs and family units, in the usual scratching and pecking manner of most pheasants. Like junglefowl they are well adapted for scratching, but they can also dig with their bills for subsurface materials such as roots and tubers.

Gaston (1981b) stated that during the post-breeding period groups of four to six birds are the typical social unit, probably consisting of a pair and their offspring. From October to December larger units of 10–12 individuals are the rule, but from January onward pairs, or males with two or three females, are the most common social groupings.

### *Movements and migration*

These birds appear to be quite sedentary, although the more northerly forms do undertake some seasonal movements associated with cold weather. They may also make movements of several miles to sources of water during late afternoon hours (Bump and Bohl 1961).

### *Daily activities and sociality*

Shortly after dawn, and again at times after 4 p.m., these birds forage in overgrown fields, or in the vicinity of roads or trails. They are often found in loose groups of from two to as many as ten, generally



in the vicinity of water, which they also visit regularly. They rest through the heat of the day, normally on the ground. Night-time roosting is done in fair-sized trees, usually at heights of 20 to 40 ft above ground. Typically the same tree is used night after night, unless the birds are disturbed (Bump and Bohl 1961).

### **Social behaviour**

#### *Mating system and territoriality*

There is considerable disagreement over the mating system of this species (Ali and Ripley, 1978; Baker 1930). Some observers have seen males in company with two or even three females during the breeding season, while others have been equally firm in asserting that the birds are monogamous, with the males regularly seen in company with females and their broods. It seems most likely that the male kalij is facultatively polygynous, leaving his first mate when she begins incubation, but remaining with his latest female to assist in rearing the young or returning to his sole mate when she hatches her brood should he be unsuccessful in fathering additional broods.

Sizes of territories are unknown, but there seems to be little doubt that territorial advertisement is well developed in males. Males have a loud crowing call, which has been described as a loud whistling chuckle or *chirrup*, but perhaps the drumming sound made during the wing-whirring display is equally important. Baker (1930) believed that the sound is made by beating the wings against the sides of the body, and quotes an earlier observation that it can be readily imitated by holding a pocket handkerchief by opposite corners and then jerking one's arms apart. Such an imitation will often bring other males on the run, suggesting that the territories may be fairly closely spaced in some habitats. It has also been compared to the noise made by shaking or flapping a piece of cloth in the wind.

#### *Voice and display*

In northern India, calling of territorial males occurs from March through May (Gaston 1981), probably corresponding to the peak of the laying period. Besides the territorial crowing mentioned above, males and females also have a variety of other vocalizations. When alarmed, both sexes utter a long, squealing whistle, which is often followed by loud and deep clucking notes. Conversational notes among undisturbed birds are also common, including low *kurr-kurr-kurrchi-kurr* sounds that seem to serve as contact signals (Baker 1930).

Besides the wing-whirring display, kalij pheasants perform a fairly simple lateral courtship, spreading

the tail, expanding the facial wattles, waltzing around the female, shaking the tail, and making clucking or booming noises (Delacour 1977). Tidbitting behaviour certainly also is present in the kalij pheasants, but does not seem to have been described in any detail. In the closely related silver pheasant the associated calls are a series of rather rapidly repeated (about five per second), low-frequency notes (Stokes and Williams 1972).

### **Reproductive biology**

#### *Breeding season and nesting*

The breeding seasons of the many subspecies of the kalij are almost as diverse as their habitats, but invariably include the period April and May. The white-crested kalij is said to breed from March to June, the Nepal kalij from April to June, the black-backed kalij from March to May, and the black-breasted from February to October, but mostly in April–May and in July–August (Baker 1930; Ali and Ripley 1978).

The more tropical forms of south-east Asia have similar breeding periods. The Williams' kalij evidently breed at least in April and May, and perhaps from March to June, the Oates' kalij breeds from March to May, and the lineated kalij from February to July (Baker 1930).

The nest itself is a slight hollow, usually in an area of abundant undergrowth, and sometimes under an overhanging rock, under a bush, or in a clump of grass. Ample cover and a reasonable proximity to water seem to be the major requirements, and the overhead canopy may vary from dense evergreen forest or bamboo jungle to fairly thin wooded cover. In nearly all races the usual number of eggs seems to be six to nine, with some clutches having as few as five and rarely more than ten (Baker 1930; Ali and Ripley 1978). Extremely large clutches of up to 14 or 15 eggs as have been reported would seem to be the result of two females' efforts or other modifications of the normal situation.

#### *Incubation and brooding*

The incubation period may vary somewhat with climate, perhaps taking an average of 20 days in the warmer portions of the range and up to 22 days in the higher and cooler elevations (Baker 1930). This is performed by the female, with the male apparently taking no role in protecting the nest. However, males have been seen in company with hens leading very tiny chicks, suggesting that as soon as hatching has occurred the male rejoins the family group. A male has even been observed tending a group of small chicks that seemingly lacked a female parent (Baker 1935).

### *Growth and development of the young*

The chicks' flight feathers grow very rapidly; and within a few days they are able to fly almost as well as their parents (Baker 1930). Renesting is probably rare, but females are known to renest if their first clutch is destroyed prior to hatching (Bump and Bohl 1961). In captivity, females often lay as many as 25 to 30 eggs in a season. The birds assume their adult plumage and are able to breed the year following hatching.

### *Evolutionary history and relationships*

The speciation pattern in all the kalij and silver pheasants is certainly the most complex of any in all the pheasant group, and has been the cause of a vast number of species and subspecies being described, many of which have been based on single specimens. Delacour (1949) was the first person to put these problems into a modern context of subspecies and to try to understand the evolution of the group. Yet, even today there are areas of taxonomic and geographic uncertainties, such as the enigmatic black kalij, and the complex diversity of male plu-

mage variations to be seen through the ranges of the kalij and silver pheasants.

### *Status and conservation outlook*

Although it is possible that some races of this species may be rather rare, the total overall distribution is great, and the birds seem to do well in a variety of both original and disturbed habitat types. The birds seem to withstand hunting fairly well (Bump and Bohl 1961), and also are highly adaptable and resistant to habitat changes (Yonzon and Lelliott 1981).

### SILVER PHEASANT

*Lophura nycthemera* (Linnaeus) 1758

Other vernacular names: none in general English use; faisan argente (French); Silberfasan (German); ing-ky, pac-ky (Chinese).

### *Distribution of species*

From the mountains of southern China (Yunnan, Fukien, Kwangsi, Kwangtung and Szechwan) southward through eastern Burma and most of Indochina; also the island of Hainan. See map 11.



**Map 11.** Distribution of Annamese (A), Berlioz's (B), Bel's (Be), Boloven (Bo), Fokien (F), Hainan (H), Jones' (J), Lao (L), Lewis (Le), Rang Jiang (R), Rippon's (Ri), Ruby Mines (Ru), Szechwan (S), true (T), and western (W) races of silver pheasant.



*Distribution of subspecies* (after Delacour 1977; Wayne 1969)

*Lophura nycthemera lewisi* (Delacour and Jabouille): Lewis's silver pheasant. Mountains of south-west Cambodia and the border of south-east Thailand.

*Lophura nycthemera annamensis* (Ogilvie-Grant): Annamese silver pheasant. Mountain forests of southern Vietnam and north-east Cochin-China.

*Lophura nycthemera engelbachi* Delacour: Boloven silver pheasant. Limited to the Boloven Plateau, southern Laos.

*Lophura nycthemera beli* (Oustalet): Bel's silver pheasant. Limited to the higher peaks and ridges of the eastern slopes on the Annamitic Range of Vietnam from Faifoo to near Donghoi.

*Lophura nycthemera berliozii* (Delacour and Jabouille): Berlioz's silver pheasant. The western slopes and plateaus of the Annamitic Chain in central Vietnam. Probably intergrades with *beaulieui*.

*Lophura nycthemera rufipes* (Oates): Ruby Mines silver pheasant. Burmese highlands of the Ruby Mines District between the Irrawaddy and Salween Rivers in the northern Shan States. Interbreeds with *Lophura leucomelana lathamii* in the lower valleys, producing unstable hybrids.

*Lophura nycthemera ripponi* (Sharpe): Rippon's silver pheasant. South-west Shan State west of the River Salween (long. 97–98° E; 20° N, approximately).

*Lophura nycthemera jonesi* (Oates): Jones' silver pheasant. Northern and central Thailand, south-west Yunnan and southern Shan States east of the River Salween and west of the Mekong.

*Lophura nycthemera rongjiangensis* Tan and Wu 1981: Rang Jiang silver pheasant. Known only from Rang Jiang, south-east Kweichow Province.

*Lophura nycthemera omeiensis* Cheng, Chang, and Tang 1954: Szechwan silver pheasant. Known only from Szechwan, in the area west and south of the confluence of the Ya Tung and Min rivers.

*Lophura nycthemera occidentalis* Delacour: western silver pheasant. Limited to north-west Yunnan and north-east Burma east of Myitkyina and Bhamo. Interbreeds at lower altitudes with *Lophura l. lathamii*.

*Lophura nycthemera beaulieui* Delacour: Lao silver pheasant. Limited to northern Laos, south-east Yunnan, western Tonkin and northern Vietnam. Intergrades with *nycthemera* in Tonkin.

*Lophura nycthemera fokiensis* Delacour: Fokien silver pheasant. Limited to north-west Fukien and probably also Chekiang.

*Lophura nycthemera nycthemera* (L): True silver pheasant. South-east China (Kwangtung and Kwangsi) and eastern Tonkin, west to the Red

(Yuan) River. Intergrades with *beaulieui* and *fokiensis*.

*Lophura nycthemera whiteheadi* (Ogilvie Grant): Hainan silver pheasant. Confined to the mountains of Hainan Island.

#### Measurements (after Delacour 1977; Cheng et al. 1978)

	Males		Females	
	Wing	Tail	Wing	Tail
<i>lewisi</i>	240–250	295–305	210–230	230–250
<i>annamensis</i>	225–250	310–355	202–245	215–255
<i>engelbachi</i>	250–270	330–415	230–248	202–272
<i>beli</i>	230–260	340–360	248 <sup>1</sup>	—
<i>berliozii</i>	255–265	370–450	—	—
<i>rufipes</i>	260–285	400–480	240–257	250–275
<i>riponi</i>	260–305	433–610	250–270	270–290
<i>jonesi</i>	260–291	440–650	150–270	250–295
<i>omeiensis</i>	276–299	765–800	266	353
<i>occidentalis</i>	285–296	560–660	246–257	260–283
<i>beaulieui</i>	270–290	430–620	245–270	265–315
<i>fokiensis</i>	261–287	610–730	220–240	250–260
<i>nycthemera</i>	265–297	600–750	240–260	240–320
<i>whiteheadi</i>	245–255	520–530	205–210	225–230
All races	225–305	295–800	150–270	202–353

<sup>1</sup> personal observation

Cheng *et al.* (1978) reported that five males of *occidentalis* weighed from 1425–1725 g, and a female weighed 1150 g. Nine males of *beaulieui* weighed 1500–2000 g, while two females weighed 1160 and 1300 g. Lack (1968) reported the weight of nominate *nycthemera* as 1150 g. Baker (1928) reported that males of *rufipes* average 3 lb (c. 1360 g) and females 2½ lb (c. 1130 g). The eggs of *nycthemera* average 51 × 39 mm, and have an estimated fresh weight of 42.8 g.

#### Description (of *nycthemera*, after Ogilvie-Grant 1893)

##### Adult male

Top of the head and crest black glossed with purple; sides of the head, back, and sides of the neck and rest of the upperparts white, the feathers of the mantle, lower back, rump, and upper tail coverts each with five or six narrow regular black concentric lines; scapulars, wing-coverts, and quills the same, but the black lines are fewer, coarser, and less regular; chin, throat, forepart of neck, and rest of underparts black, glossed with purple, some of the feathers on the sides of the breast with white shaft-stripes, others with the whole of the outer web white. Tail unusually long; centre pair of tail feathers pure white, rest white with irregular oblique black lines



gradually increasing in number and thickness towards the outer pair. Bill greenish horn; facial skin blood-red; legs and feet scarlet.

#### *Adult female*

Crest blackish brown; top of the head, rest of upperparts, and middle pair of tail-feathers olive-brown, more or less vermiculated with fine dusky lines; inner webs of the quills brown; chin and throat dirty brownish white; neck and rest of underparts similar to the upper, but feathers of the belly, thighs, and under tail-coverts mottled and vermiculated, especially the latter, with black; second pair of tail feathers brownish buff, obliquely vermiculated with brownish black; outer pairs black; obliquely vermiculated with white. Colours of soft parts like those of the male, but not so bright.

#### *Immature male*

Upperparts like those of the female, but most of the feathers of the wing-coverts have narrow bars of buff edged with black running parallel to the margin; outer webs of the secondaries obliquely vermiculated with black and buff lines; most of the feathers of the chin, throat, and chest black, glossed with purple, but the majority of the feathers on the rest of the underparts marked with alternate black and white or black and buff lines running parallel to the edge; tail as in the female.

### Identification

#### *In the field* (20–50 in.)

The male silver pheasant is easily recognized in most areas by virtue of its thick, black, decumbent crest, contrasting with a white neck and generally black underparts, and a very elongated tail that is white centrally and boldly barred with black and white laterally. The male's usual display call is similar to that of a *Phasianus* male, but is more guttural. A loud wing-whirring is also characteristic. Females have somewhat elongated tails, which are olive-brown centrally and are heavily marked with brown and black lines outwardly. The flanks are also more heavily marked with bolder patterning than is typical of female kalij pheasants.

#### *In the hand*

The male is easily separated from all species except possible the kalij, which sometimes hybridizes with it and produces confusing individuals, but generally the relatively long and whitish tail (over 300 mm) and the bold black markings on the lateral tail feathers provide for identification. Similarly, the female has a fairly long tail (usually over 225 mm)

that is strongly patterned with dark brown and black lines laterally. Like the males, females are also distinctly crested, separating them from most *Lophura* species except the kalij and the crested fireback, which latter species has a vertically rather than posteriorly oriented crest.

### Geographic variation

Geographic variation is great, especially in males, and is locally influenced by hybridization with the kalij pheasant. Some of the variation is clinal, such as tail length. Thus the shortest tail lengths are found in the southernmost forms (*lewisi* and *anna-mensis*), while the longest tails occur in the northernmost race (*omeiensis*). The southernmost forms also show some traits that approach the plumage conditions found in the kalij pheasant, such as the white shaft-streaks and white V-shaped markings on the sides and flanks, and blackish wing and tail-coverts, with relatively narrow white lines. Proceeding northward, the white on the back, upper wing-coverts and outer tail feathers begins to predominate over the black, making the barring less intense and the bird generally lighter above. However, in *omeiensis* the outer tail feathers are mostly streaked with grey, or are even entirely black (on the three outermost pairs of feathers) (Delacour 1977; Cheng 1979).

### Ecology

#### *Habitats and population densities*

This species, although closely related to the kalij, appears to be adapted to a considerably more grass-like and less forest-like environment. Baker (1930), in referring to the race *ripponi*, described the habitats as consisting of hills covered either with a sea of grass, with light deciduous forest, or in places where these are mixed with and broken up by ravines and pockets of more dense jungle, often more or less of evergreen type. Its preference, however, is for broad areas of grassland that are bordered by forests, especially where these areas are rough and broken up by rock outcrops. Its elevational range is from less than 5000 ft to at least 9000 ft, and is most common in Yunnan at about 7000 ft, where it is found in thin oak forests that occur as small patches among higher grasslands, and where denser vegetation occurs only on stream borders and in large ravines. In such areas the forest patches of stunted oaks dot the grasslands, where the grasses are from one to three feet high, and where the male's white-and-black plumage pattern blends beautifully with the sun-bleached expanses of grasses (Baker 1928). In Thailand the local race has been collected as low as

2500 ft, but usually occurs above 4500 ft (Deignan 1945).

Cheng (1963) states that in China this species lives at elevations of from 1500–2000 m above sea level, in forested uplands, bamboo groves, and 'straw beds'. Beebe (1918–1922) observed the birds in Fokien, in mountainous areas where brushy bamboo and sprouting pines were locally present amidst a dense vegetational blanket of ferns.

Delacour reports that the southernmost race *lewisii* occurs in thick evergreen forests of Cambodia above 2500 ft, while the more easterly race *annamensis* occurs in central Vietnam, usually above 4000 ft in mountain forests of pines or other evergreens. The Boloven race occurs in very wet forests of southern Laos, between 2000 and 5000 ft, while Berlioz' and Bel's races occur in the mountains of Vietnam, mostly between 2000 and 5000 ft, in fairly dry and relatively damp forests respectively. The westernmost race, *occidentalis*, occurs in the mountains of Yunnan and Burma, between 6000 and 7000 ft, where it encounters the black-breasted kalij and hybridizes with it locally. The true or nominate silver pheasant is found from the foothills of eastern China as high as 5000–6000 ft, and is particularly associated with bamboo woods and evergreen forests. The Hainan race is limited to the damp mountain forests of that island (Delacour 1977).

There do not appear to be any estimates of population densities.

#### *Competitors and predators*

Nothing specific seems to have been written on these subjects. In some areas the silver pheasant overlaps with and locally hybridizes with the kalij (Delacour 1948, 1949). It probably also locally overlaps with red junglefowl, common pheasants, and koklass pheasants.

### **General biology**

#### *Food and foraging behaviour*

Beebe (1918–1922) noted that the specimens of this species that he examined had eaten insects primarily, as well as a smaller amount of various beetles and occasional flower petals and leaves. Rutgers and Norris (1970) stated that the major foods are berries, other fruits, seeds, grain, young shoots and leaves, grass, insects, small reptiles, and worms. In winter they subsist on grain, roots, tubers, and bulbs.

Their foraging behaviour is essentially like that described for the kalij, consisting of scratching and occasional digging behaviour, but the sounds of scratching are sometimes loud enough to reveal the birds' locations (Beebe 1918–1922).

#### *Movements and migrations*

Beebe (1918–1922) was able to detect no special pattern or movements or the location of any roosts, and believed that the birds wandered about with little definite direction in view. Like the kalij pheasants, the birds are great runners, tending to flee uphill, and taking to flight only when they reach the top (Cheng 1963).

#### *Daily activities and sociality*

Roosting is apparently done in trees; Cheng (1963) reported that hunters sometimes use torches to aid in hunting perched birds. Foraging is done during the morning and again at dusk, while during the middle hours of the day the birds tend to hide.

The birds evidently move about in small groups while foraging; Baker (1930) quotes a correspondent who observed a flock of seven or eight birds that were flushed from the crest of a grassy ridge, and Beebe observed a group of three (two females and a male) during March.

### **Social behaviour**

#### *Mating system and territoriality*

Nearly all writers are agreed that this species is polygynous, which is of interest considering the disagreements revolving around the comparable information relative to the closely related kalij. However, perhaps the more definite tendency toward polygyny in this species is related to its more grassland-associated niche as compared to the forest-adapted kalij. From two to five females per male appear to be typical of this species, with the groups remaining together throughout the year, under the domination of the male in typical harem polygyny.

Territories are evidently proclaimed by a combination of crowing and wing-whirring. The crowing is said to resemble that of the common pheasant, but is shorter and deeper in tone (Baker 1930), while Beebe (1918–1922) stated that it is kalij-like, being broken, semi-liquid, semi-harsh and guttural.

#### *Voice and display*

Beebe (1918–1922) reported that courtship is typically composed of a definite utterance, combined with wing-whirring. The male approaches the female in an indirect, sidling manner, then stops, faces her, stands erect, and utters a two-syllable *ohr-chac* note, with the first syllable accented. Immediately thereafter he whirrs his wings, and then runs or walks swiftly around the female, spreading his tail and wings, and exhibiting them laterally or frontally to the view of the female. Wing-whirring may also occur as a sign of suspicion or alarm, but in this



case it is typically a short quick beat, followed by a long roll. Wing-whirring behaviour has also been observed in females, but its function in females is not well understood, and perhaps it serves as a warning signal or as some type of contact communication. Male wing-whirring is shown in Fig. 21.

## Reproductive biology

### *Breeding season and nesting*

Cheng (1963) reported that in China the breeding season begins in April. Although no wild nests have been described, in captivity the birds produce clutches of four to 14 eggs, with up to an average of about 24 eggs being produced per female each season. Farther south, the Ruby Mines race of silver pheasant is believed to breed at least in March and April, and probably also in May (Baker 1930). Two

females collected in Thailand in mid-May both had bare incubation patches, indicating a similar period of breeding there (Deignan 1945).

### *Incubation and brooding*

At least in captivity, the incubation period lasts 25–26 days. The male takes no part in this, although he may visit his sitting mate once or twice a day during this period (Rutgers and Norris 1970).

### *Growth and development of the young*

For the first two weeks after their hatching, the female alone is said to care for the chicks. Later she takes them to join her mate and his harem, although they continue to roost separately with her, until they are completely independent. At that time she joins the communal roost with the male and his other females. However, should anything happen to the female, the male is said to assume parental

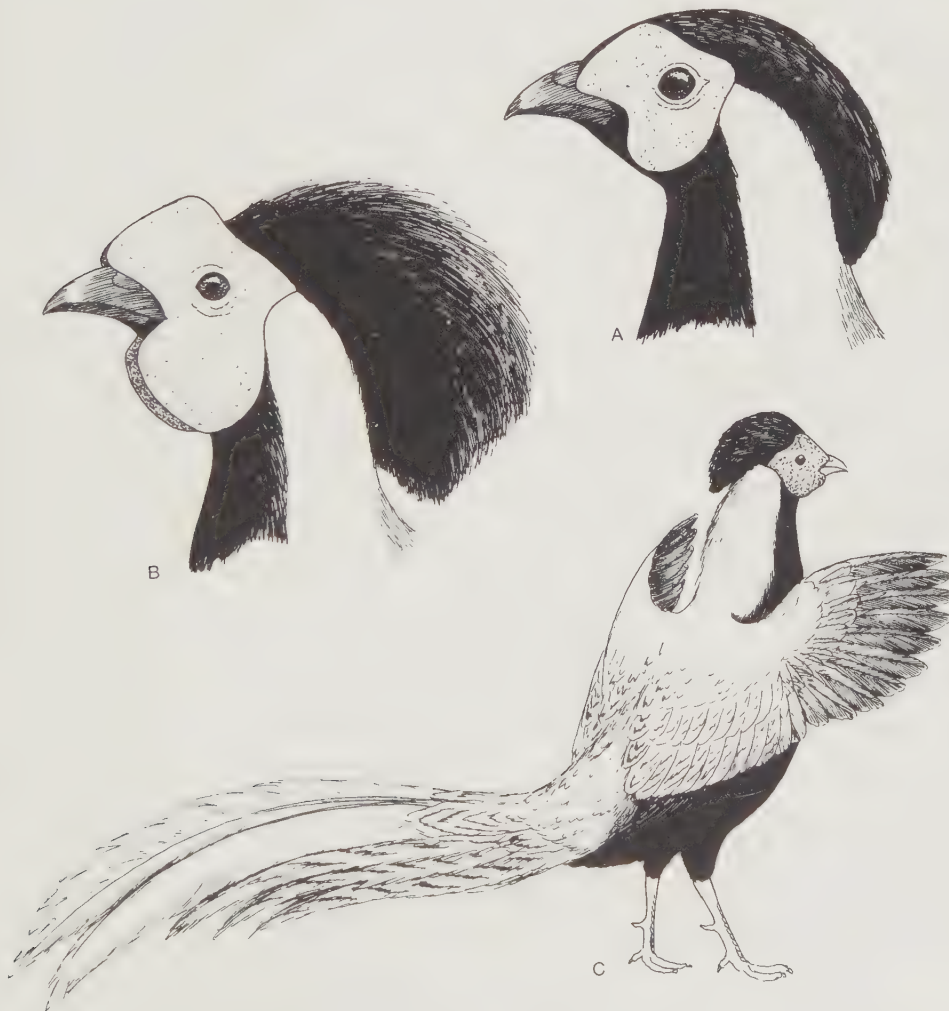


Fig. 21. Postures of the male silver pheasant, including normal (A), facial engorgement with crest-raising (B), and wing-flapping (C). After various sources.



responsibilities (Rutgers and Norris 1970). Two years are required for the attainment of full plumage and sexual maturity.

### Evolutionary history and relationships

There can be little doubt that the kalij pheasant is the nearest relative to the silver pheasant, and that the two forms probably evolved in southern or tropical and more highly forested habitats (kalij) versus northern or temperate and more grassy habitats (silver pheasant) respectively. The silver pheasant exhibits a higher level of sexual dimorphism than does the kalij, and this seems to be related to a higher propensity for polygyny, in conjunction with an edge- and grassland-adapted niche. The strongly contrasting male plumage pattern, with its anti-concealing colour pattern of black below and white above, is of considerable interest, and leads one to wonder about the social importance of white in the male's plumage.

### Status and conservation outlook

The relatively broad range of this species, and its apparent ability to utilize woodland edge habitats as well as secondary succession community types such as bamboo thickets probably bodes well for its future.

### SWINHOE'S PHEASANT<sup>1</sup>

*Lophura swinhoi* (Gould) 1862

Other vernacular names: Formosan kaleege; *faison de Swinhoe* (French); *Formosa-Fasan*, *Swinhoe-Fasan* (German), *Wa-kōe* (Chinese).

#### *Distribution of species*

The island of Taiwan (Formosa) between 1000 and 7000 ft, primarily in primary or mature secondary hardwood forests (Severinghaus 1980). See map 9.

#### *Distribution of subspecies*

None recognized.

### Measurements

Delacour reported that males have wing lengths of 250–260 mm and tail lengths of 410–500 mm, while females have wing lengths of 240–245 mm and tail lengths of 200–220 mm. Two unsexed adults averaged 1100 g (U. Seals, *in litt.*). The eggs average 51 × 38 mm, and have an estimated fresh weight of 40.6 g.

<sup>1</sup> Vulnerable species (King 1981).

### Description (after Delacour 1977)

#### *Male*

A short white crest, slightly mixed with blue-black as in *edwardsi*; head, neck, and underparts silky blue, also like *edwardsi*; a large white patch on the upper back; lower back, rump and upper tail-coverts much as in *edwardsi*, but the black subterminal bar of the feathers narrower and the metallic blue border wider; scapulars silky crimson-maroon; wing-coverts black with shining green borders; two central rectrices white, much elongated and pointed, the others dark blue. Iris reddish brown; face wattles red, highly developed, showing when erected four lobes, the upper one very long; bill horny yellow, blackish at base; legs crimson.

#### *Female*

No apparent crest; crown chestnut-brown narrowly barred with black; face and throat pale grey; upper back, scapulars, and wing-coverts vermiculated chestnut and black on the tip and borders, with two arrow-shaped marks of buff and black in the centre, forming a showy pattern; back, rump and upper tail-coverts mottled black and brown; central rectrices mottled black and brown with irregular buff bars, the others bright deep chestnut red; breast feathers rusty buff with several V-shaped black lines fading on the sides and abdomen. Iris brown; bill horny yellow, dark at base; legs crimson.

#### *First-year male*

Crest black and white; head, neck and underparts blue as in the adult, but duller, sometimes black; white patch of the upper back more or less mixed with chestnut, scapulars mottled brown, with a variable amount of crimson showing in some cases; rest of upperparts bottled brown and black, with black and metallic blue or green borders to the feathers; central rectrices chestnut mottled with black, sometimes with a variable amount of white on the inner webs, the others black. There is a very great deal of individual variation.

#### *Juvenile*

Much like the female, only duller; mantle vermiculated chestnut and black; wing-coverts with two subterminal black spots separated by a whitish patch and bordered with fulvous.

### Identification

#### *In the field* (20–32 in.)

This species is limited to Taiwan, where the only other native pheasant is the distinctly different mikado pheasant. Males of the Swinhoe's pheasant have

white crests, white mantles, and white central tail feathers, providing a colour combination unique in the genus. Females lack crests and have much shorter tails than do female mikado pheasants. The male performs a noisy wing-whirring display, and also utters a loud, penetrating, plaintive and rather high-pitched call, which is apparently associated with mild alarm. A sharper, rapidly repeated, and high-pitched *deek* note is uttered in greater alarm.

#### *In the hand*

Males are readily identified by their combination of a white crest, a white mantle, and pointed white central tail feathers, but otherwise are almost entirely iridescent purplish black. Females have red legs and red facial skin, and no apparent crest. They also have chestnut-red outer tail feathers, while the central pair are heavily barred with brown, black and buffy, as are the wing feathers. They thus are rather similar to the females of the Siamese fireback, but are less whitish on the underparts and have less rufous on the breast and mantle.

### Ecology

#### *Habitats and population densities*

The habitats of this rare species in Taiwan are best described by Severinghaus (1980). He stated that the species was most observed by him in primary, undisturbed evergreen tropical forests at elevations of between 1800 and 2300 m. These forests, unlike the 'jungle' environments that were earlier ascribed to the Swinhoe's pheasant, tend to be shady and park-like with dappled sunlight penetration, and scattered shrubs and ferns present as an understorey. Dominant trees consist of several genera of oaks (*Castanopsis*, *Cyclobalanopsis*, *Lithocarpus*) and laurels (*Cinnamomum*, *Actinodaphne*, *Machilus*). The lowest records of the species were obtained as low as 100 m, and the highest at nearly 2500 m. The majority of sightings occurred in primary vegetational habitats such as mixed forests and coniferous forests, while about a fifth were made in various secondary habitats such as cassava fields, bamboo plantations, natural secondary forests, and the like. However, most of these disturbed habitats showed some characteristics of primary forests, such as mature trees, closed canopies, lack of grassy areas, or little forest undergrowth. Apparently the birds prefer relatively gentle slopes, but not flat terrain.

No detailed estimates of population density are available, but during winter (December) individual males seemed to be separated by intervals of about 100 m, and similar spacing seemed to be present during March and April (Severinghaus 1980). If typical,

this is suggestive of a very high pheasant density in some habitats.

#### *Competitors and predators*

Except for the mikado pheasant, the Swinhoe's pheasant is primarily sympatric with the Formosan hill partridge. These two species seem to forage together regularly, and may actually benefit from the others' presence, since they uncover food in different ways. The Swinhoe's pheasant tends to dig with its bill to excavate food, while the hill partridge uses kicking movements to dislodge forest litter. The pheasant often digs in areas previously cleared by the partridge, and thus might benefit from its presence (Severinghaus 1980).

Little is known of the species' predators, but the most likely mammalian predator other than man is the ferret-badger (*Melogale moschata*), according to Severinghaus (1980).

### General biology

#### *Food and foraging behaviour*

This species is evidently quite catholic in its food preferences, and a variety of plants have been mentioned as probable or known foods. These include acorns, berries (including *Damnacathus*) flower buds (*Polygonum*), leaves (probably of *Neolitsea* and *Aplenium*), and various other plant parts including those of *Actinodaphne*, *Cammellia*, *Cordia*, *Gardenia*, and the cultivated exotic cassava (*Manihot*). Cassava was the only cultivated exotic on the list of known plant species, and it is presumed but not certain that the birds feed on the starch-filled roots. The seeds of wild taro (*Alocasia*) have also been mentioned as probable foods. As well as unidentified animal materials, earthworms, millipedes, termites, and other insects have been mentioned (Severinghaus 1980).

Foraging is done in open areas of the forest floor, with the birds sometimes using one foot to clear the ground cover, but not scratching. Digging is the usual method of reaching food, but the birds have also been observed jumping to reach items that are just beyond their reach (Severinghaus 1980).

#### *Daily activities and sociality*

Most foraging activity occurs in early morning and again in late afternoon, with the birds foraging in herbaceous cover of second-growth vegetation or near the edges of roads. Roosting is apparently done singly, although in December as many as eight birds have been reported in a single tree. Birds probably go to roost shortly after sunset, and have been observed leaving roosts shortly after dawn. One roost site was about one or two metres above ground, in an area of



secondary undergrowth of saplings and small trees within an area of heavier forest. Most pheasant activities seem to occur before 8 a.m., and after 4 p.m., at least between mid-December and early April. Later in the spring the periods of morning activity become earlier, and the afternoon sightings also become later, as might be expected. Little activity occurs between 8 a.m. and 4 p.m. when the birds are quite inactive and perhaps roosting (Severinghaus 1980).

### **Social behaviour**

#### *Mating system and territoriality*

Severinghaus (1980) suspected that this species is polygynous under wild conditions, although he was able to obtain no firm data on this point, and all of the sightings of birds other than single individuals were of pairs rather than in harem groupings. He mentioned that Philip Wayre believed the birds to be monogamous, based on experiences with feral birds on Brownsea Island, off the English coast. The relatively dimorphic plumage pattern of the species might favour the idea that polygyny is the usual situation, although in the similar kalij pheasant there is almost as much plumage dimorphism associated with a reported commonly monogamous mating system.

Severinghaus (1980) said that his observations suggested that this species is territorial, but he was able to get no direct information on territorial sizes other than an apparent spacing of males at approximate 100 m intervals along certain census roads. Calling was only rarely heard in a context that might have been related to territorial advertisement, and he learned of only one report of fighting among males.

#### *Voice and display*

Severinghaus (1980) described three calls for this species, including a 'murmuring call', a 'sharp call', and a 'plaintive call'. None of these calls fits the criteria that might be expected of a male advertising call; the murmuring call apparently being associated with foraging behaviour, and the sharp call with intense alarm. The plaintive call was heard only by males, and carried at least 100 yd, and was a high-pitched series of notes sounding like repeated oot syllables, broken with a pause only at long intervals. This call seemed to be associated with mild alarm.

Stokes and Williams (1972) sonographically illustrated the tidbitting call of this species, which is very similar to that of other *Lophura* types. Several persons (Delacour 1977; Wayre 1969) have mentioned the male's typical courtship posture, which is characterized by extreme enlargement of the facial

wattles, so that the upper lobe reaches well above the crest of the head (Fig. 22). The male then performs a series of stiff-legged hops around the female, bobbing the head up and down, interspersed with much wing-whirring (Kenneth Fink, personal communication).

### **Reproductive biology**

#### *Breeding season and nesting*

Reports from Taiwan suggest that egg-laying there probably begins in March, or rarely even in February, and extends to May and with a few scattered reports occurring even as late as October. Probably the peak of laying is from March through May, with later records the result of reneesting efforts rather than any well-defined second breeding period (Severinghaus 1980). The clutch-size in the wild has been reported as from as few as two to as many as 12 eggs, but with most reports ranging from three to eight eggs. Reports of larger clutches are largely based on observations in captivity, where clutches of 10 or 12 eggs seem to be fairly common.

Most observers are in agreement that the Swinhoe's pheasant nests on the ground, although about a quarter indicated that elevated positions are used. Typically the site is described as being next to a fallen tree, or in spaces beneath the trunk, between the roots, among rocks, or in clumps of vegetation (Severinghaus 1980). One elevated tree nest observed by Severinghaus was 5 m above ground, in the depression of a tree stub where the trunk had broken off. This nest contained five eggs, and was located in a primary hardwood forest.

#### *Incubation and brooding*

The incubation period is apparently of 25 days, and is performed by the female alone. There is no evidence of the male defending the nest site.

#### *Growth and development of the young*

At least in captivity, the chicks of this species are readily raised, and require no special attention. Two years are required for the attainment of full plumage in males, and for full development of reproductive maturity.

### **Evolutionary history and relationships**

Zoogeographically speaking, it would seem that the silver pheasant might be this species' nearest relative, although it is also obviously very close to the Edwards' pheasant in both plumage and ecology. The appearance of white in the male's plumage is of interest, and is seemingly non-adaptive as a concealing mechanism in heavy forest cover. However,



Severinghaus (1980) suggested that the pattern has a disruptive visual effect that might be adaptive in heavy forest habitats.

#### Status and conservation outlook

This species is currently considered as vulnerable by the ICBP (King 1981), and its protection has been aided by the formation of a sanctuary of 3680 ha of high-altitude habitat in 1974. Severinghaus (1980) judged that at least as of 1974 the birds were widely distributed on Taiwan, and that their numbers were still probably in the thousands. He believed that its preservation will depend on the presence of sufficient habitat in the form of primary hardwood forests. The captive population of this species is

relatively favourable, and it breeds fairly easily under those conditions. In 1967 and 1968 a limited number of hand-raised birds were released in an area of forest belonging to National Taiwan University in the central mountains, and there was some later indications that the birds had survived well (King 1981).

#### SIAMESE FIREBACK

*Lophura diardi* (Bonaparte) 1856

Other vernacular names: Diard's fireback; faisan prélat (French); Praelat, Prälatfasan (German); Kai-pha (native Siamese).

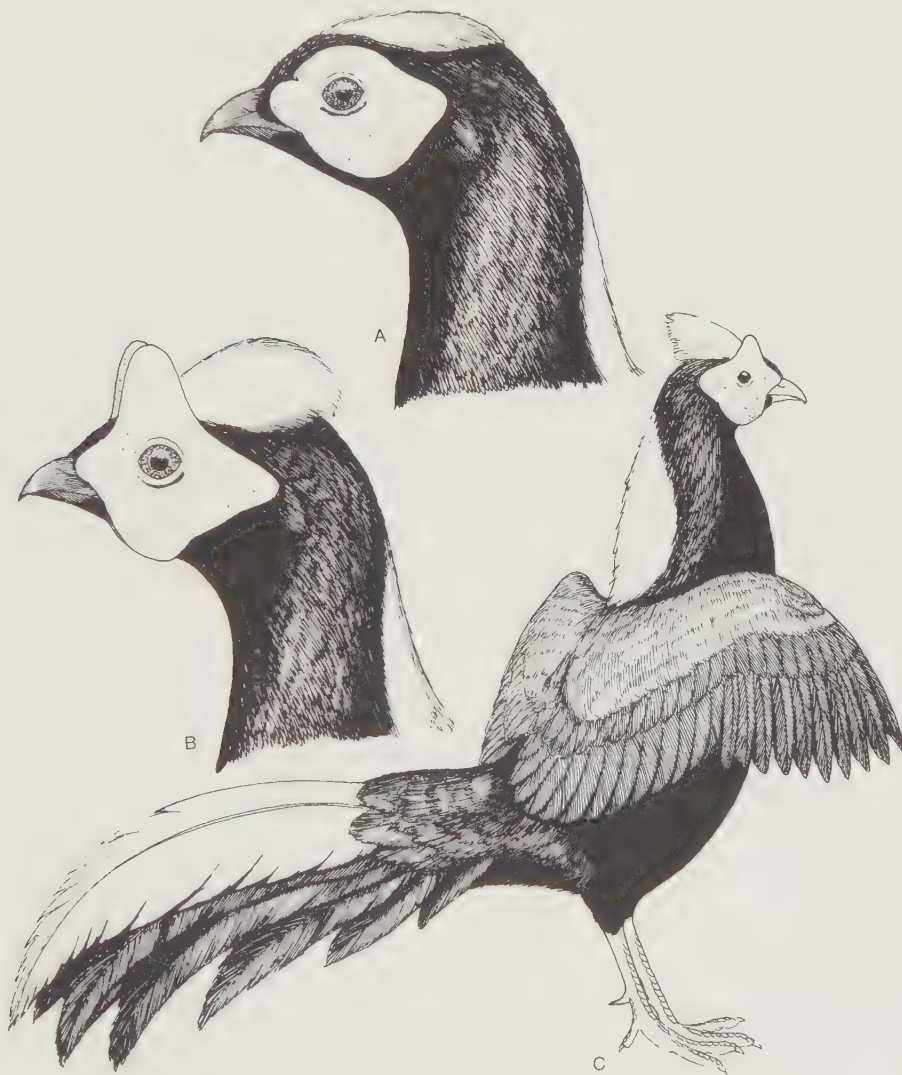


Fig. 22. Postures of the male Swinhoe's pheasant, including normal (A), facial engorgement (B), and wing-flapping (C). After various sources.

*Distribution of species*

Indochina north to central Vietnam and to Luang-Prabang (Laos) on the Mekong; eastern Thailand as far west as the River Yom and the Klum-Tan mountains (Wayre 1964). In dense growth from sea level to 2000 ft. See map 9.

*Distribution of subspecies*

None recognized.

**Measurements**

Delacour (1977) reported that males have wing lengths of 220–240 mm and tail lengths of 330–360 mm, while females have wing lengths of 220–240 mm and tail lengths of 220–260 mm. An adult male weighed 1420 g, while an adult female weighed 1025 g (East Berlin zoo, *teste* Wolfgang Grummt). Two females at the San Diego zoo weighed 680 and 800 g. (D. Rimlinger, *in litt.*). The eggs average 48 × 38 mm, and have an estimated fresh weight of 38.2 g.

**Description (after Delacour 1977)***Male*

Long crest (70–90 mm) of purple-black feathers, with disintegrated barbs, very short at the lower two-thirds where the shaft is almost bare, normally drooping backwards and erected only when the bird is excited; face wattles large and red, head, chin and throat black; neck, upper breast and upper back grey with fine vermiculations; middle of back bright yellow, the feathers with golden fringes; lower back and lesser tail-coverts metallic blue with coppery crimson fringes; greater tail coverts and rectrices metallic black with blue and green reflections, the central pair shorter than the third; the tail feathers are broad, falcate, strongly curved, the points held slightly outwards, generally showing off the sides; wing-coverts grey, vermiculated with black and having a wide, irregular black bar near the tip, forming conspicuous and peculiar markings; secondaries vermiculated grey and black; primaries brownish grey; lower breast, sides, and under tail-coverts black with large blue fringes; abdomen and thighs black. Iris red to hazel brown; bill pale horny green; legs crimson, with white spurs and claws.

*Female*

No visible crest, the feathers of the crown only very slightly elongated, head, throat, and neck dull brown, paler on the chin; upper back and underparts bright chestnut-red, becoming vermiculated with black on the back, and bordered with white on the lower breast and sides; wings, lower back, rump, upper tail-coverts, and two central pairs of rectrices

black, largely barred with buffy white freckled with black and tinged with chestnut-brown; other rectrices plain chestnut; abdomen pale grey. Iris red to brown; bill horny black; legs crimson.

*Juvenile*

Like the female but duller, the males soon showing grey feathers. Young males assume their adult plumage the first year, but are somewhat duller, and have shorter tails. Breeding does not usually occur until the third year, although second-year birds may also be fertile.

**Identification***In the field* (24–32 in.)

Limited to the forests of south-east Asia, this species is unique in that males have the combination of scarlet facial skin and a posteriorly oriented crest that expands into a comma-like shape. The long, iridescent tail also droops gracefully downward, and there is a small area of maroon colouration on the back that is less extensive than in the other fire-backs. The male has a whistling call and continually utters a loud, repeated *pee-yu*, as well as performing wing-whirring displays. Females lack an obvious crest, but have upper wing surfaces and elongated central tail feathers that are black with distinctive broad, broken, buffy-white barring.

*In the hand*

The male's maroon back, red facial skin, and comma-like crest serve to identify this species in the hand. Females resemble those of some other *Lophura* species, but none of these is so strongly barred on the wings, wing-coverts, and tail feathers, or is so uniformly rufous on the upper mantle and breast.

**Ecology***Habitats and population densities*

This species is associated with the densest kinds of cover, including lowland evergreen forests, bamboo brakes, and areas of old cultivation that have been overgrown with *Eupatorium* and thorns (Deignan 1945). It occurs from sea level to about 2000 ft, and is most commonly encountered along roads that have been cut through the jungle (Delacour 1977).

There are no estimates of population densities.

*Competitors and predators*

This species apparently inhabits much the same habitats as does the red junglefowl although it is probably limited to more dense and generally wetter



forests. Their predators have not been identified, but probably include a wide array of cats, mustelids, and raptors.

## General biology

### *Food and foraging behaviour*

These birds evidently forage during morning and late afternoon hours, either as single birds or in family groups (Delacour 1977). They are believed to forage on all kinds of fruit, berries, insects, worms, small land-crabs, and the like, in a relatively omnivorous way (Baker 1928). In captivity they are reported to favour animal foods, such as insects, but can survive on normal pheasant diet (Howman 1979). In the wild they are said to search for insect food in the vicinity of cattle or buffalo, and forage by scratching about in the forest mould (Beebe 1918–1922).

### *Movements or migrations*

There is no reason to believe that movements of any substantial size occur in this species, as there are very few seasonal changes in temperature or precipitation patterns where the Siamese Fireback occurs.

### *Daily activities and sociality*

Delacour (1977) reported that these birds are found in groups ranging from single males to large family parties while they are foraging in morning and late afternoon hours.

## Social behaviour

### *Mating system and territoriality*

At least in captivity, this species is reportedly monogamous (Delacour 1977), and perhaps this is also the case in the wild, although there is no information on this point.

Nothing is known of its territoriality, but the male utters a rather loud whistling call, and also performs a typical *Lophura* wing-whirring display (Fig. 23). Both of these are probably important acoustic signals in the species' dense forested habitats.

### *Voice and display*

Besides its whistling call, which is probably a territorial challenge or at least a mate-attracting call, males are said to utter continually a loud, repeated *pee-yu* call (Delacour 1977). This is perhaps similar to the food-call shown sonographically by Stokes and Williams (1972), which consists of a series of equally spaced notes uttered at the rate of about three per second, and which is associated with tidbitting behaviour.

Probably wing-whirring is a major male sexual display, but it is equally probable that lateral display, which would expose the highly colourful rump patches, is also an important part of courtship.

## Reproductive biology

### *Breeding season and nesting*

There are relatively few actual dates of nesting from wild birds. Riley (1938) stated that a group of four eggs was collected on 25 May, and another egg was obtained on 22 June. There is also a record of a single set of eight eggs obtained on 19 April, and an incomplete set of eggs obtained on 2 May. Baker (1928) reported that the first of these two clutches was from a nest found on the ground in a hollow tree, and that both of the adults were trapped on the nest. That observation would favour the view that the birds are indeed monogamous under natural conditions.

### *Incubation and brooding*

In captivity, the incubation period has been determined to be 24–25 days, or typical for the genus *Lophura*. The clutch-size in captivity ranges from five to eight eggs, which can be assumed to be the normal clutch for wild birds as well, given the limited information from that source.

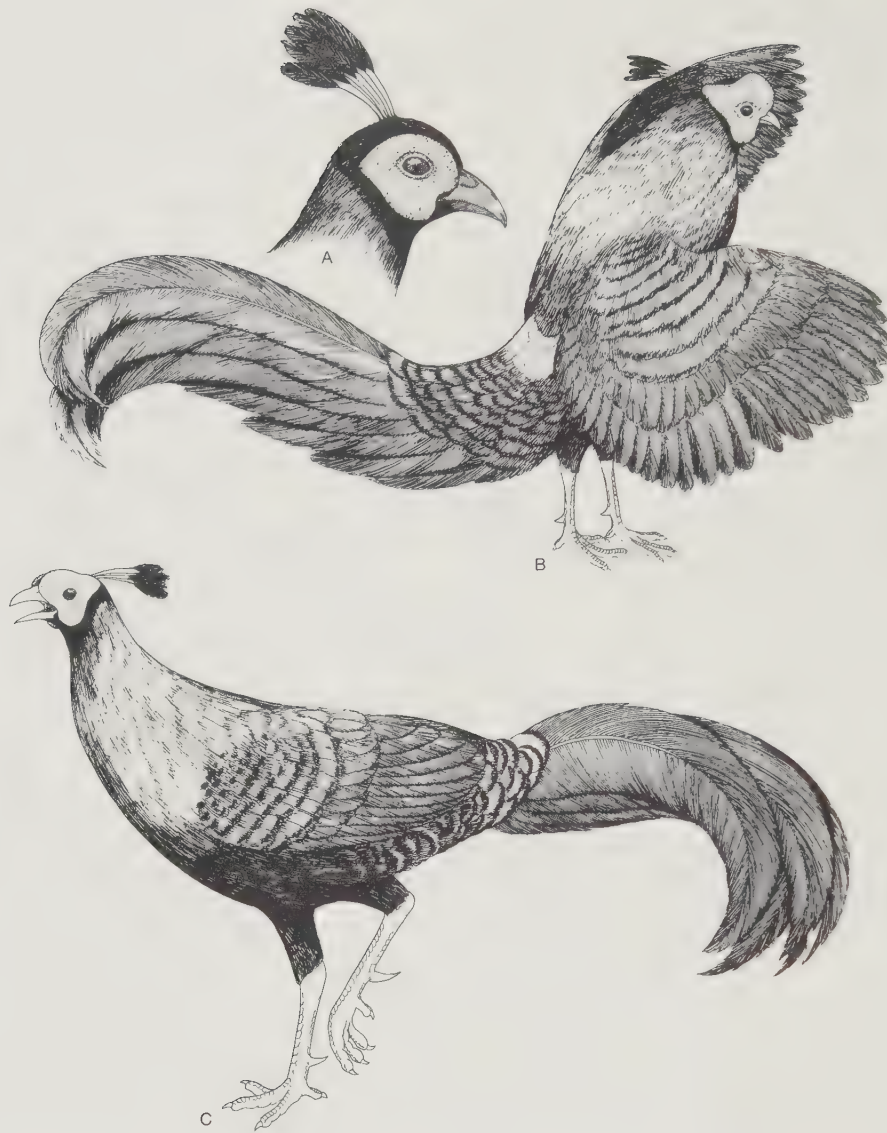
### *Growth and development of the young*

Nothing is known of this under natural conditions, but in captivity the chicks are said to be easy to rear, although they need shelter from direct sunlight, and are quite susceptible to diseases such as paratyphoid. The young males become fully coloured before they are a year old, but their tails increase in length during their second year, when they breed for the first time. Females, however, may not breed until they are three years old (Delacour 1977).

## Evolutionary history and relationships

Certainly this species is a close relative of the crested and crestless firebacks, and its current range is not distantly removed from that of the Vieillot's crested fireback. Of the entire group the Bornean crestless fireback would seem to be the most generalized form, based on its simple tail structure and lack of a crest, and it might easily be imagined as an evolutionary ancestral plumage type to the present-day Siamese fireback. The species is also rather kalij-like in posture and proportions, and in that respect seems somewhat transitional between the kalij pheasants and the typical firebacks.





**Fig. 23.** Postures of the Siamese fireback, including normal (A), wing-flapping with facial engorgement (B), and calling (C). After photographs by the author and Lincoln Allen.

### Status and conservation outlook

Little is known of the status of this species, but deforestation in Thailand is going on at a horrendous rate, reducing the surface area of Thailand from 56 per cent forested in 1960 to only 25 per cent by 1978 (Boonlerd 1981). About 15 per cent of the remaining forest lands, some 8 million acres, are now protected as national parks and wildlife sanctuaries, while about 85 per cent are composed of national reserved forests that are managed for timber production. The Siamese fireback is known to occur in at least one of the nation's wildlife sanctuaries, Panom Dongrek, in Srisaket Province, and almost certainly occurs in

several others (Boonlerd 1981). Some recent efforts have also been made to raise this species in captivity at a breeding centre at Bangpra, using birds that were obtained from England.

### CRESTLESS FIREBACK

*Lophura erythrophthalma* (Raffles) 1822

Other vernacular names: rufous-tailed pheasant; fais-san à queue rousse (French); Gelbschwanzfasan (German); kuang-bestam, meta-merah (Malay); singgier (Borneo).

*Distribution of species*

Borneo, Sumatra, and adjoining Malay Peninsula, in lowland forests. See map 8.

*Distribution of subspecies*

*Lophura erythrophthalma erythrophthalma* (Raffles): Malay crestless fireback. Lowland forests of Malay Peninsula north to Kedah, and of Sumatra.

*Lophura erythrophthalma pyronota* (G. R. Gray): Bornean crestless fireback. Lowland forests of northern Borneo.

**Measurements**

Delacour (1977) reported that males of *erythrophthalma* have wing lengths of 240–250 mm and tail lengths of 150–180 mm, while females have wing lengths of 200–220 mm and tail lengths of 140–160 mm. Two males of *erythrophthalma* averaged 1043 g, while female weighed 837 g. (various zoo records). No weights are available for *pyronota*. Eggs (*erythrophthalma*) average  $47.8 \times 35.5$  mm, and have an estimated fresh weight of 33.2 g.

**Description (of *erythrophthalma*, after Delacour 1977)***Male*

Head crestless; face wattles scarlet, large, the two upper lobes high and pointed in display; crown, throat, ear-coverts and neck purplish black; mantle, wings and sides of body purplish black finely vermiculated with silvery grey; middle back metallic copper passing to silky maroon on the rump; upper tail-coverts glossy dark purple with maroon fringes; tail of fourteen or sixteen cinnamon rectrices, the middle pair a little shorter than the second and third, rounded, short and straight, held slightly upwards and looking like that of a domestic hen; breast purplish black with silvery shafts and a few tiny, more or less visible spots; rest of underparts black. Iris reddish brown; bill greenish white, blackish at base; legs bluish grey, with a strong spur.

*Female*

Entirely black except for the brownish head and smoky chin and throat; the feathers are strongly glossed with steel blue in their exposed part except on the abdomen, thighs, and vent. Iris brown; bill black, pale at lower base; facial wattles scarlet; legs bluish grey, always with a sharp spur as in the male, but smaller.

*Immature*

Black with rufous chestnut tips to the feathers; the female is darker and has a black tail. Feathers of the

adult type soon appear in the male, and at least in *erythrophthalma* the adult plumage is attained by time the birds are four months old.

**Identification***In the field* (16–20 in.)

This species is limited to lowland forests of Malaya, where it occurs in company with the crested fireback. It differs from that species in having red facial skin and grey feet, rather than blue facial skin and red feet. The male also lacks a crest, and has a short, rufous tail that lacks elongated and drooping central feathers. The male utters a low, croaking and repeated *tooktaroo* call, and has a noisy wing-whirring display. Females are extremely dark-coloured, being almost uniformly glossy bluish black except for a more brownish head and a greyish throat. They also have red facial skin around the eyes.

*In the hand*

Males are the only pheasants with fairly short (under 200 mm) and rounded tails that are uniformly rufous in colour. Females are likewise the only pheasants that are essentially glossy black except for their more brownish to greyish head and throat, and red facial skin around the eyes. They tend to resemble males of the Salvadori's pheasant, but have a longer (30–33 mm) and darker bill, and a shorter (max. 220 mm) wing.

**Geographic variation**

Geographic variation is relatively slight, and is mostly limited to males. Those from the northern parts of the range (*pyronota*) have neck and upper back feathers that are light grey, with white shaft-streaks and fine black speckles, rather than being purplish black with silvery grey vermiculations. Additionally the feathers of the breast and sides are more lanceolate, and have wide white shaft-streaks, while the upper tail-coverts are more bluish and the rectrices are black basally. Females of the two races are usually indistinguishable (Delacour 1977).

**Ecology***Habitats and population densities*

This species is limited to primary and tall secondary forests habitats, probably at elevations no higher than 3000 ft (Smythies, 1981; Robinson and Chasen, 1936).

Beebe (1918–1922) observed the Malayan subspecies in light jungle habitat also occupied by gibbons, red junglefowl, hornbills, babblers, and sunbirds. In



Borneo he found the birds in dense evergreen forest, where the trees were festooned with lianas and lichens, and where thorns and briers were abundant, including a thorny rattan palm.

There are few estimates of population densities, but Davison and Scriven (in press) stated that in Malaysia the species occurs in lowland and hill dipterocarp forests growing on level, gently sloping and steep substrates, from sea level up to 200 m and perhaps higher, but not to the upper limits of hill dipterocarp forests. Densities on logged forests with a dense palm undergrowth were fairly high (6.0 birds per km<sup>2</sup>), and lower in forests on level ground with mixed dry and swampy terrain (3.0 birds per km<sup>2</sup>), and still lower in forests over level ground in mixed alluvial terrace, dry and swampy land (0.6 birds per km<sup>2</sup>).

#### *Competitors and predators*

This species occurs in the same area as the crested fireback, and very possibly competes with it, while in Borneo it also occurs with the wattled pheasant, which has similar habitats and probable foraging requirements. Davison and Scriven (in press) stated that in Malaysia the crestless fireback and crested firebacks seem to have non-overlapping ranges, and exclusion of the crestless species occurred when populations of the crested fireback increased.

There are no discussions of possible predators of this species, but Beebe (1918–1922) observed a zebra civet in an area of this species' Bornean habitat, and quite possibly it and other civets of the region are potential predators, as are mongooses and various felids. Beebe reported the birds to be relatively tame and easily trapped or shot, often frequenting the vicinity of isolated huts or even hamlets, and judged them to be quite vulnerable to human exploitation.

### **General biology**

#### *Food and foraging behaviour*

The only definite information on this subject comes from Beebe (1918–1922), who observed that the crops of the birds he examined contained about an equal amount of plant and animal material, with termites frequently consumed, whilst ticks and 'grubs' were less often encountered. Small, hard berries were found in the crops of two males.

Feeding is done in a fowl-like manner, with much scratching of the forest floor, producing a good deal of noise. However, they seldom utter a sound while thus foraging, and occasionally stop to listen for possible danger (Beebe 1918–1922).

#### *Movements or migrations*

There is little reason to believe that these birds are anything but fairly non-mobile. There is no definite

information of movements of these birds currently available, but Wayre (1969) concluded that the birds are probably sedentary.

#### *Daily activities and sociality*

Very few observations have been made on these birds in the wild, but Beebe (1918–1922) observed a pair of birds foraging together, which remained close together but 'apparently had no great affection for each other', since they sometimes pecked at one another and twice threatened one another with their spurs. He believed that the unusual development of spurs in females of this species was indicative of a tendency for females to be active in courtship behaviour in a more or less reciprocal manner. The birds seem to feed at all hours of the day, and spend the nights roosting well up in trees. Water holes were visited during early morning hours. Beebe said that the sexes were approximately equal in the coveys or flocks that he observed, but he did not specify flock size except for a single flock of 22 birds, which was seemingly the largest group he encountered. Robinson and Chasen (1936) stated that flocks of five or six birds are common, typically being composed of a single male and four or five females, although at times two males may be present.

### **Social behaviour**

#### *Mating system and territoriality*

Beebe (1918–1922) judged that perhaps this species was polygynous, but tended to question this possibility because of the presence of sharp spurs in the females. No other observers have added new information on this point, although Wayre (1969) suggested that males and females may form a loose bond for much of the year.

#### *Voice and display*

Medway and Wells (1976) reported that the vocalizations of this species include a vibrating, throat purr, a loud *kak* of alarm, and a repeated, low-pitched *tak-takrau*. Mr David Rimlinger (personal communication) informed me that during lateral display the male lowers the near wing, raises the far wing, and enlarges the facial wattles. He also vertically spreads and tilts the tail toward the object of the display. These postures have been observed toward females as well as toward males of other species.

### **Reproductive biology**

#### *Breeding season and nesting*

According to Medway and Wells (1976), eggs have been found in April and in June on the Malayan



Peninsula. Coomans de Ruiter (1946) has described the nest and eggs of the Bornean subspecies, but very little is known of the natural nesting of either of these two species. However, a clutch of five eggs was found in June of 1965 in Selangor, Malaysia, in a nest placed between the roots of a large tree. Three young were later hatched from this clutch in an incubator (Jarvis and Medway 1968). Three years later a female from this clutch laid her first eggs in a large aviary. Two nests were made by her, both of which were scrapes in sand among a cluster of pre-cast concrete culvert sections. Six eggs were laid, over a period of 12 days. The female built her nest in the usual galliform manner of sideways-throwing of nesting material, and although the male approached the nest he never assisted in this activity. During the egg-laying period the female would spend the night-time hours perched with her mate. Incubation behaviour did not begin until two days after the laying of the last egg.

#### *Incubation and brooding*

In the nest studied by Jarvis and Medway (1968), the female brooded both day and night from 26 February to 28 March, leaving the nest only for short periods to feed, drink, dust-bathe, etc. The eggs proved to be infertile.

#### *Growth and development of the young*

These birds have not been reared in captivity commonly. However, Delacour (1977) stated that the chicks are easy to rear, and are not susceptible to diseases. The birds do not mature until their second year, but thereafter females may produce up to three clutches in a single breeding season.

#### **Evolutionary history and relationships**

This would certainly appear to be the most generalized form of fireback, and indeed might vie with the Salvadori's pheasant for being one of the most generalized forms of the genus *Lophura*. Its geographic distribution is also appropriate for a centralized and ancestrally derived type of *Lophura*.

#### **Status and conservation outlook**

Certainly the future of this species will depend upon the preservation of adequate areas of primary or mature secondary forests in both Borneo and Malaysia, where much deforestation is occurring at present (Davison 1918c).

#### CRESTED FIREBACK

*Lophura ignita* (Shaw and Nodder) 1797

Other vernacular names: Viellot's fireback; fasian noble (French); Rotrückenfasan (German); ayam pëgar, ayam suil (Malaya); sempidan (Borneo).

#### *Distribution of species*

Malaya, Sumatra, Borneo and Banka Island, in dense lowland forests. See map 12.

#### *Distribution of subspecies*

*Lophura ignita ignita* (Shaw and Nodder), lesser Bornean crested fireback. Kalimantan and Banka Island.

*Lophura ignita nobilis* (P. L. Sclater): greater Bornean crested fireback. Sarawak and Sabah, in northern Borneo.

*Lophura ignita rufa* (Raffles): Viellot's crested fireback. Malay Peninsula to the Isthmus of Kra; Sumatra, except the south-east where it intergrades with *macartneyi*.

*Lophura ignita macartneyi* (Temminck): Delacour's crested fireback. South Sumatra, Province of Palembang and parts of the Lampongs, south-east Sumatra.

#### *Measurements*

Delacour (1977) reported that males of *ignita* have wing lengths of 270–280 mm and tail lengths of 245–260 mm, while females have wing lengths of 234–254 mm and tail lengths of 156–177 mm. In *nobilis* the males have wing lengths of 280–293 mm and tails of 254–285 mm, while females have wing lengths of 252–270 mm, and tail lengths of 265–295 mm respectively. Males of *rufa* have wings of 270–300 mm, and tails of 265–295 mm and those of *macartneyi* have wings of 270–300 mm. Lack (1968) reported the adult weight of *rufa* as 1800 g. Beebe (1918–1922) reported the females of the Borneo and Malayan forms to weigh about 1600 g, and males of those two forms to average about 2040 and 2265 g, respectively. Riley (1938) reported that five males of *rufa* weighed from about 1812–2605 g (average 2175 g). The eggs of *ignita* average 54 × 40 mm, and have an estimated fresh weight of 47.6 g.

#### **Description (of *ignita*, after Delacour 1977)**

##### *Male*

Face wattles cobalt blue, of the same shape as those of the silver pheasant, that is to say with one large lobe forming a half circle above the eye, and one lower lobe developed forward; head, crest, neck, breast, mantle, rump, tail-coverts, and thighs silky



**Map. 12.** Distribution of Delacour's (D), greater (G), lesser (L), and Vieillot's (V) races of crested fireback. Approximate current distribution of primary forests in these areas is also shown by fine stippling; the species' actual distribution is probably confined to such habitats.

dark purplish blue; wing-coverts dark blue with iridescent ultramarine fringes; primaries and secondaries bluish black; feathers of lower back blue-black at base, hidden by broad fringes of shining coppery maroon; rump and upper tail-coverts with large metallic blue fringes; three central pairs of rectrices cinnamon-buff, the remaining five pairs bluish black; there is much individual variation, the third pair sometimes black on its inner web, the fourth sometimes with some buff on the outer web; lower breast and sides of body shining coppery chestnut; abdomen black. Iris red; bill horny white; legs greyish white to flesh colour.

#### *Female*

Head, crest and upperparts rufous chestnut, the wings and tail-coverts finely vermiculated with black; rectrices black, finely vermiculated with dark chestnut on the edges; chin and throat white; feathers of breast, sides and thighs chestnut to blackish brown with white borders producing a scaly effect; abdomen white. Soft parts as in the male, but base of the bill brown; no spur in normal birds; legs sometimes tinged with brown.

#### *Juvenile*

Dark brown and female-like, but the wing-coverts with large dark spots, and the male darker. Young males assume their adult plumage in the first autumn, but do not begin to breed until their second year of life.

#### **Identification**

##### *In the field* (24–28 in.)

This species, limited to Borneo and the Malayan Peninsula, is vertically crested in both sexes and also has distinctive blue orbital skin patches in both sexes. Additionally, males have white to cinnamon central tail feathers, which are vaulted and decurved, and brilliant maroon colouring on the lower back and rump. The major vocalizations include a sharp, squirrel-like *chukun*, *chukan*, uttered as an alarm call; a long squealing call is sometimes also uttered. Wing-whirring is commonly performed as well. Females are generally cinnamon-coloured dorsally, and have blue facial skin and a short vertical crest. The tail colouration varies from bright chestnut to black in different subspecies.



*In the hand*

The distinctly vertically crested condition of males, together with their bluish facial skin, maroon rump, and otherwise purplish body iridescence provides for easy identification. Females have a similar vertically crested condition and also have blue facial skin, providing a combination that separates them from all other *Lophura* species.

**Geographic variation**

Geographic variation is well marked and is partially clinal. Within Borneo, there is a slight cline in size, with the southern race (*ignita*) somewhat smaller than the northern one. Bornean (and Banka Island) males are separable from those from farther west inasmuch as they have central tail feathers that are cinnamon-buff to chestnut-coloured, rather than pale buff to white, and their sides, flanks, and anterior underparts are coppery chestnut, while in the more western forms these areas are dark blue, with whitish shaft-streaks. Additionally, the more easterly races have whitish rather than crimson legs, have two rather than four lobes on the facial wattles, and these wattles have no red spots as are present in *rufa*. Females of *rufa* and *macartneyi* have bright chestnut rather than essentially black tails (Delacour 1977), and also have most distinctly reddish legs, while those of *ignita* are sometimes tinged with brown.

**Ecology***Habitats and population densities*

In Malaysia, this species was found by Beebe (1918–1922) in tangles of thorny palms and enmeshed vines that cover areas of once-cleared lands that often are close to small streams in low-lying valleys. Likewise, in Borneo the birds occur in bamboo and other jungle thickets with abundant vines, near jungle rivulets, and in heavily overgrown vegetation. Thick evergreen forests, often near rivers, and at relatively low elevations, seem to represent their most typical habitats in both areas.

Davison (1981a) has analyzed the habitat requirements of this species in Malaysia, and found that, of 45 sightings, the majority were in moist forest areas where invertebrate food supplies were plentiful. The birds were seen in nearly every vegetation type, and were most often observed close to rivers (40 per cent of the sightings were within 100 m of a river), especially in riparian fringes and within limits of the flood forest.

There are few estimates of population densities, but Davison and Scriven (in press) stated that in

Malaysia this species has been estimated to occur at densities ranging from 2.67 birds per km<sup>2</sup> to 10.67 birds per km<sup>2</sup> at the same site, with variations apparently affected by seasonal wandering. In a second site the estimate was 8.5 per km<sup>2</sup>. The species was observed by Davison (1981a) only in low-land dipterocarp forests growing on level alluvial riverine terraces near moderate to large rivers.

*Competitors and predators*

Davison (1981a) has concluded that the crested and smaller crestless species are probably competitors, and that the latter is excluded from habitats occupied by the former in Malaysia. Although crested firebacks seem to require riverine forests, the crestless species can also exist in non-riverine and more hilly forests, and thus tends to be displaced into such areas to varying degrees, depending upon the density of crested firebacks in a particular area.

No specific information is available on predators of this species.

**General biology***Food and foraging behaviour*

Davison (1981a) believed that foraging is typically done solitarily, with the birds obtaining plenty of protein rich invertebrate life by picking up single large food items from the litter surface. Among these foods is the crab *Sesarma*, and there are other abundant animal foods in the moist riverine habitats. During the time that the young are initially present there is an abundance of fruit, but as they grow the abundance of both fruit and invertebrates declines, according to Davison.

Beebe (1918–1922) noted that among the birds he examined the crops were filled mostly with leaves and seeds, with insects only occasionally predominating. Among the insects were ants, small beetles, and grubs. In several cases an acorn-like fruit was also present.

*Movements or migrations*

These large birds seem to be fairly mobile, and Davison (1981a) noted considerable variations in population densities in a single study area that in part he attributed to the birds' mobility. In some cases movements of individual birds of several hundred metres (up to 300 m in a week) were observed. He regarded these observations as reflecting a shifting core area, within a larger and more stable home range, with the latter seemingly overlapping among individuals. However, the core areas of males were well spaced and perhaps averaged less than a hectare in size, while the total home ranges seemed to be from about 20 to 25 ha.

*Daily activities and sociality*

Beebe (1918–1922) found that the birds roosted in trees of medium size, and would leave in early morning toward the nearby river. In the middle of the day they would sometimes return to the roost, but on other days they apparently did not. Davison (1981a) saw only single birds between January and June, except for a single January sighting of a female and her previous-year's brood. He believed that pairing and laying occurs (in Malaysia) from June to August, and that flocking of broods occurs in September, with a gradual breakup of these groups as the young grow. Although usually found only in rather small flocks of up to about six birds, one flock of as many as 16 has also been observed (Davison 1981a).

**Social behaviour***Mating system and territoriality*

This species has no loud calls to announce its territory, and wing-whirring is probably the major territorial or self-assertive display of males. It was heard by Davison (1981a) only during the period May to June, during the time when pairs were seen, and may be important in attracting mates.

As noted earlier, males during the pre-breeding period of May to June maintain rather small core areas within larger home ranges, and these core areas tend to be well spaced, perhaps also serving as mating territories. Although the situation in the wild is not very clear, in captivity the birds appear to be monogamous, and are best maintained in pairs (Ollson 1982).

*Voice and display*

Beebe (1918–1922) described the male's combination vocal and wing-whirring challenge as sounding like *wooon-k!* (whirrrr). Davison (quoted by Baker 1930) described the male's call as a *chukun*, *chukun*, followed immediately by a whirring sound best imitated by rapidly twirling a small stick in a cleft in which a piece of stiff cloth has been transversely placed.

The typical lateral display of the fireback is characterized by a great engorgement of the male's wattles, a high degree of fluffing of the plumage, and a rather slow and measured waltzing around the female (Fig. 24). This posture appears to be the same or very nearly the same in two subspecies. Behaviour associated with tidbitting has not yet been described.

**Reproductive biology***Breeding season and nesting*

Davison (1981a) judged that the breeding season in Malaysia occurs between June and August, during a period of high fruit availability. Few nests have been found, but there is an old record of eggs obtained in April, and supposedly taken from a nest of dead leaves, grass and bamboo-spates under some low bushes in dense evergreen jungle (Robinson and Chasen 1936). In Borneo, four newly hatched chicks were collected in late July in the Kimanis Bay area (Smythies 1981).

*Incubation and brooding*

At least in captivity, the incubation period is 24 days. Beebe (1918–1922) observed that a female laid six eggs at intervals of one and two days, and then incubated for 24 full days. During this time the male performed 'guard duty' several yards away from the nesting site. He apparently never closely approached the nest, but guarded it very fiercely. As soon as the chicks hatched, however, the male joined his mate, and thereafter they were together constantly.

*Growth and development of the young*

Beebe (1918–1922) reported that the male parent took his full share in feeding the young birds hatched by its mate, and would call them to him for feeding as often as did the hen. Within a week of hatching the young were able to use their wings, and when alarmed would fly off in various directions rather than squatting down as they had done earlier. By the first autumn of life the young birds closely resemble their parents. However, although they attain full plumage their first year, they do not become reproductively mature until their second or sometimes even their third year (Howman 1979, Ollson 1982).

**Evolutionary history and relationships**

It is fairly easy to imagine the derivation of the crested fireback as from an ancestral Bornean type similar to the modern crestless species, perhaps on Sumatra or Malaysia, with a secondary invasion of Borneo by the crested form and of Sumatra and the Malay peninsula by the crestless one following the completion of speciation.

**Status and conservation outlook**

The future of the crested fireback in its native range depends on the survival of suitable primary forest



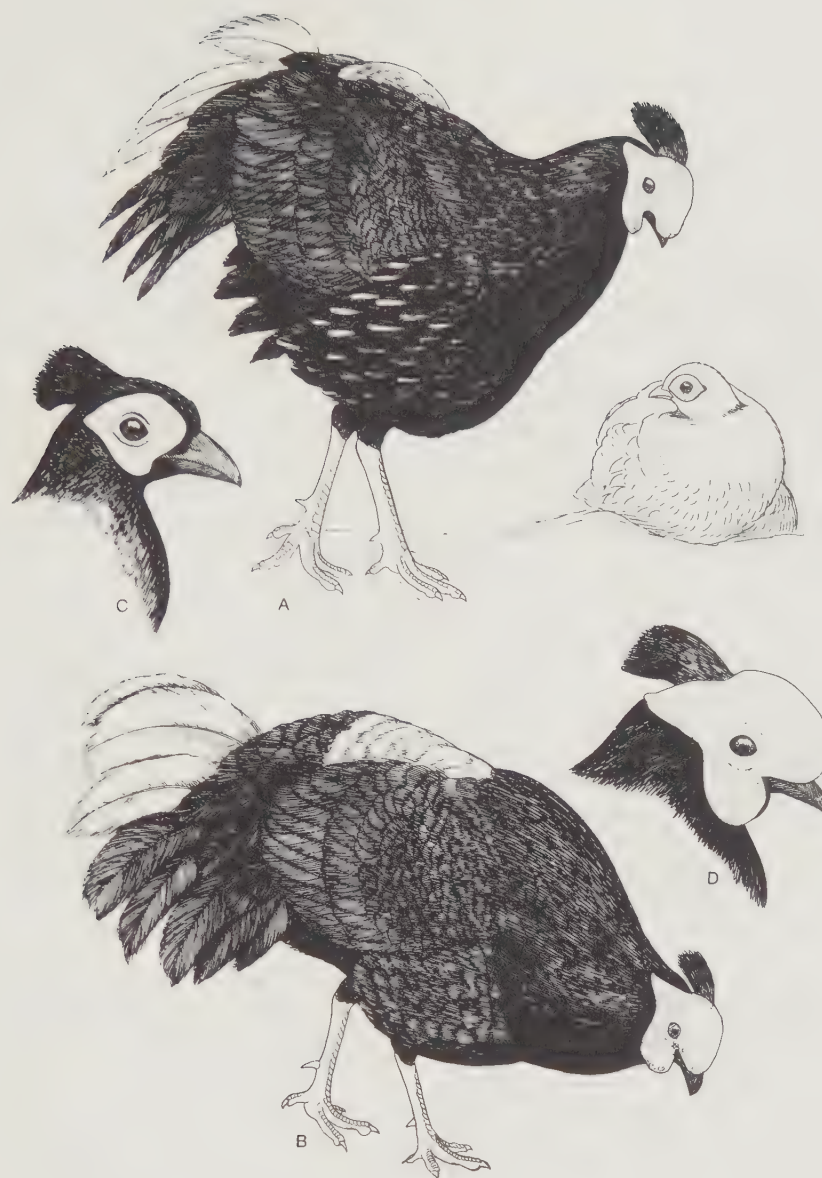


Fig. 24. Postures of the male crested fireback, including lateral display by Vieillot's race (A), lateral threat by greater Bornean race (B), normal head posture (C), and facial engorgement (D). After photographs by the author.

habitats (see Map 12). On the Malay Peninsula about 42 per cent of the total land area is still covered by forest (15 per cent lowland, 27 per cent montane), whilst on Sumatra the percentage is about 57 per cent, on Java about 23 per cent, and on the island of Borneo (Sarawak, Sabah, and Kalimantan collectively) the various political subdivisions contain from 25 to 70 per cent forested habitats (Davison, 1981c). The Malay race is protected locally by the large Taman Negara National Park (Davison 1981c), and in Sumatra it also occurs in Gunung Leuser National Park (Sumardja 1981). In Borneo there are

two proposed reserves in the eastern and southern parts of Kalimantan, but little is known of their pheasant faunas.

#### WATTLED PHEASANT<sup>1</sup>

*Lophura bulweri* (Sharpe) 1874

Other vernacular names: Bulwer's pheasant; white-tailed wattled pheasant; bau-en (Dutch Borneo); faisan de Bulwer (French); Bulwer-Fasan (German).

<sup>1</sup> Vulnerable species (King 1981)

*Distribution of species*

Borneo, in lowland forests and mountain slopes up to about 4500 ft. See map 8.

*Distribution of subspecies*

None recognized.

**Measurements**

Delacour (1977) reported that males have wing lengths of 255–260 mm and tail lengths of 450–460 mm, while females have wing lengths of 225–235 mm and tail lengths of 175–190 mm. Four males had weights of 1470–1800 g, averaging 1615 g, and two females weighed 916 and 1004 g. (D. Rimlinger, *in litt.*) The eggs average  $50.7 \times 40.3$  mm, and have an estimated fresh weight of 45.3 g.

**Description (modified from Delacour 1977)***Male*

Face wattles tremendously developed, the upper lobe near the nape and the lower lobe near the gape, when extended in display, forming ribbon-like, rigid flaps, the two constituting long, gentle arcs some 180 mm in length. The wattles are bright sky blue, with a black band on the uneven, serrated top of the two long lobes, and the lower lobes gradually attenuating to pointed tips; a crimson ring round the eye. No crest; head and upper neck black glossed with blue; chin and throat dull black and thinly feathered; foreneck and upper breast shining crimson-maroon, the feathers disintegrated, with a very thin blue border; lower breast dull black with metallic blue spangles at the tip of the feathers; rest of underparts dull black; feathers of upperparts black with a subterminal band of black with rich crimson reflections and terminal iridescent blue spangles forming an interrupted fringe of great brilliance; feathers of the rump truncated, with large blue fringes; secondaries black; primaries dark brown; tail of thirty to thirty-two rectrices, long, broad and falcate, the seven outer pairs with the tip of the shaft thick, stiff and naked of barbs except for short spicules; upper tail-coverts and rectrices snow white. Iris crimson; bill black, the tip pale horny; legs crimson; spurs sharp but small.

*Female*

General colour light chestnut brown very finely vermiculated with black, the neck almost plain and pale, the chin and throat whitish; the underparts are lighter and slightly vermiculated, the wings darker and richer with coarser markings; tail of 26 feathers, deep chestnut with small markings. Face wattles

blue, with a crimson ring around the eye, of average size and shape in relation to other *Lophura* hens, the lobes just indicated; iris red; bill black with pale horny tip; legs crimson.

*First-year male*

Body plumage like the adult, the blue fringes reduced in width and the crimson maroon colour more apparent; tail of 24 feathers short and straight, dark chestnut; the face wattles much like those of the female, only larger, the long lobes just indicated; spurs short.

*Juvenile*

Like the female, but the wing-coverts are tipped rich buff with V-shaped subterminal black marks.

**Identification***In the field (22–32 in.)*

This Bornean endemic is unlikely to be confused with any other Bornean pheasants, inasmuch as the male has a uniquely white, fan-like tail that contrasts with an otherwise blackish body and blue facial skin. The female also has bluish facial skin, like that of the crested fireback, but unlike that species it has no crest. The female is otherwise almost uniformly dark brown. At the peak of the breeding season the males utter a shrill piercing cry, but otherwise are relatively silent. Wing-whirring also occurs during display.

*In the hand*

Adult males are instantly recognizable on the basis of their entirely white tail and their blue facial skin. Females are almost entirely chestnut-brown, with fine vermiculations, a deep chestnut tail (175–190 mm), and blue facial skin. Apart from their blue facial skin, they very closely resemble in shape and colour the females of the Edwards' and imperial pheasants.

**Ecology***Habitats and population densities*

This is a submontane species associated with mature forests, which apparently is quite patchily distributed in Borneo. It has been observed at least as high as 4500 ft on Mt Mulu, and is apparently usually found in the vicinity of larger rivers and streams (Smythies 1981; Beebe 1918–1922).

There are no estimates of its population density.

*Competitors and predators*

At least in some areas this species certainly comes into local contact with the crestless fireback, and



perhaps also at lower elevations with the crested fireback, but at present nothing can be said of any competitive interactions that might occur.

Likewise, the species' predators are unknown, although Beebe (1918–1922) mentioned that many of the birds that are caught in snares set by natives are devoured by civet cats unless they are promptly found and removed. He judged that the immaculate white tail of males must make the birds highly conspicuous in their heavily shaded environment, and thus probably they are more readily taken by predators.

## General biology

### *Food and foraging behaviour*

Beebe (1918–1922) concluded from the crops that he examined that these birds are about equally insectivorous and frugivorous, eating ants, small crickets, and other orthopterans, while termites were second only to ants in actual numbers. Small seeds and a nutlike fruit were also present in the crops. Like others of their genus, the birds feed by scratching in the forest floor, alternating these feeding movements with short periods of intense alertness for possible danger.

### *Movements or migrations*

There is no information on this, but Beebe (1918–1922) implied that the birds are apparently localized and sedentary, usually occurring on the first ridge of jungle stretching back from the upper reaches of a river, and extending back no farther than the second ridge.

### *Daily activities and sociality*

Beebe saw a reputed roosting site of this species, which was near the top of a small hill in low jungle, and in an isolated, slender, and smooth-barked tree. He observed most birds only in the morning and late afternoon hours, suggesting the usual pattern of daily activity found in most or all tropical pheasants. He believed that the birds made regular morning and evening trips from the hilly jungle areas to river banks to drink each day. He made no comments on group sizes larger than four; he twice saw groups of both parents attending two young.

## Social behaviour

### *Mating system and territoriality*

The high level of sexual dimorphism in this species might suggest that it is polygynous, but as just noted, Beebe (1918–1922) mentions twice seeing paired birds with young. This would suggest that

monogamy is at least occasionally present in the species.

Nothing of certainty can be said of territoriality. At the peak of the breeding season the male utters a shrill piercing cry (Heinroth 1938), which is presumably territorial in function, or at least may serve to space out males and perhaps attract females.

### *Voice and display*

In addition to the just-mentioned loud call of the male, which is uttered from a normal walking posture (Fig. 25), the birds also utter alarm *kak* notes, and a penetrating and rather metallic *kook!*, *kook!* note that may serve as a contact or 'covey' call (Beebe 1918–1922).

The marvellous display of this species has been described by various authors (Beebe 1918–1922; Heinroth 1938; Muller 1980), and is one of the most remarkable of all pheasants. Its major features are the raising of the white tail feathers into a narrow, almost circular disk-like shape, with no indication of the spreading that Beebe assumed might sometimes take place. The wattles are engorged (Schneider 1938) into a double structure resembling the elongated tines of a hammer, extending several inches above and below the head, and largely obscuring the head with the exception of the red eye, which is made even more conspicuous by the enlargement of an oval eye-ring. From the side, the beak is wholly obscured by the blue facial wattle, which also expands forward in a shape that almost mimics that of the bill itself.

In this posture the bird may perform wing-whirling (Fig. 25), but more commonly he simply struts about silently, except for the scratching sounds made by the shafts of the outer tail feathers, which scrape along the ground as the bird moves forward or, with a hiss, swivels about while standing in place. The intensity of the posturing varies with the closeness of the male to the female, as does the degree of engorgement and erection of the wattles. It should be noted that the shape of the wattles as illustrated by G. E. Lodge in Beebe's monograph and also in the accompanying plate by Major Jones is incorrect; thus the sketches (Figs. 25–26) should be used for obtaining a proper idea of their actual shape.

I have not observed a typical waltzing behaviour in this species, but David Rimlinger (*in litt.*) has observed tidbitting behaviour. Copulatory behaviour has not yet been described for this species.

## Reproductive biology

### *Breeding season and nesting*

Beebe (1918–1922) judged that the breeding season in Borneo is quite prolonged, since immatures obtained in August suggested an approximate April



**Fig. 25.** Postures of the male wattle pheasant, including calling (A), facial engorgement (B), and full lateral display (C). After photographs by the author.

breeding period, while courtship was also observed as late as July. Nests in the wild are still undescribed, but Beebe believed that the clutch was probably only of about two eggs, based on native reports and his observations of broods of only two young.

#### *Incubation and brooding*

A wild-caught female that was bred during 1974 in Mexico laid three eggs in a clump of bamboo in a well-planted aviary, and later C. Sivelles stimulated a female to lay by placing nest boxes in similar bam-





**Fig. 26.** Postures of the male wattled pheasant, including calling (A) and wing-flapping (B). After photographs by Lincoln Allen.

boo clumps. Sivellev judged from his experience with captive birds that the typical clutch may be of five eggs rather than only two, as Beebe surmised. Females owned by Mr Vern Denton laid most of their eggs in April and early May, with most of a

total of 18 eggs laid during 1976 being produced by a single female (Delacour 1977).

*Growth and development of the young*

Incubation in captivity has been found to require 24–25 days, with the young birds proving to be

easily raised on game bird crumbles, chick grains, vitamin supplements, peanut hearts, supplemented later on with fruits such as bananas, apples, and oranges. By the age of two months they were feeding on the usual game bird pellets, with small additional amounts of milo, peanut hearts, and herring meal mixed in as well as mealworms, fresh fruit, and medicated water. Young males begin to show their distinctive colours by about six months of age. Adults moult their tail feathers with surprising frequency. Some males apparently moult these feathers up to four times a year, but one fertile male moulted his twice a year (Delacour 1977).

### **Evolutionary history and relationships**

This is certainly the most distinctive and seemingly remote form of *Lophura*, with no obvious close relatives. The downy young are very much like those of

the crested fireback, and thus it seems most likely that the firebacks are the nearest if still rather isolated relatives of this species.

### **Status and conservation outlook**

Deforestation of this species' habitat is proceeding rapidly in Borneo; how much it is affecting the welfare of the bird remains unknown. However, the species does occur in Gunung Mulu National Park of Sarawak (Davison 1981c). About 20 per cent of the land-mass area of Sarawak and Kalimantan is still (as of 1978) about 70 per cent forested with montane or lowland forest (see Map 12), so perhaps there are still good populations of this bird left in spite of the high rates of lumbering activities, and still time to set aside more areas for it and other forest-adapted wildlife.



## 9 · Genus *Catreus* Cabanis 1851

The cheer pheasant is a medium-sized montane pheasant in which sexual dimorphism is slight and in which both sexes have long, narrow occipital crests. A large red orbital skin area is present, and the plumage is generally grey to buffy, with black barring and spotting, and the highly graduated tail likewise is strongly barred with buff, black, and brown. The wing is rounded, with the tenth primary shorter than the first, and the sixth the longest. The tail is of 18 rectrices, with the central pair up to five times the length of the outermost pair. The tail moult is phasianine (centripetal). The tarsus is fairly long, and spurred in the male. A single species is recognized.

### CHEER PHEASANT<sup>1</sup>

*Catreus wallichi* (Hardwicke) 1827

Other vernacular names: chir pheasant, Wallich's pheasant; faisán de Wallich (French); Wallich-Fasan (German); kahir, chihir (Nepal); tshi-er (Kumaon and Garwhal).

#### *Distribution of species*

The Himalayas, from Durung Galli and the Hazara district of Afghanistan to Simla States, Tehri Garwhal, and Nepal. In temperate forest, scrub, and meadows between 4000 and 10 000 ft. See map 13.

#### *Distribution of subspecies*

None recognized.

### Measurements

Delacour (1977) reported that males have wing lengths of 235–270 mm and tail lengths of 450–580 mm, while females have wing lengths of 225–245 mm and tail lengths of 320–470 mm. Males weigh from 3¼ lb to 3¾ lb (c. 1475–1700 g), and females from 2¾ lb to 3 lb (c. 1250–1360 g); (Ali and Ripley 1978). However, Baker (1928) reported the weight of males as 2 lb 10 oz to 3 lb 7 oz (rarely 4 lb) and females from 2 to 2¾ lb (c. 900–1250 g). The eggs average 53.4×49.3 mm, and have an estimated fresh weight of 71.6 g.

### Description (after Baker 1928)

#### *Adult male*

Top of head and crest blackish-brown, edged paler and tipped with grey; upper nape the same but with the grey tips larger; line below bare orbital space and ear-coverts hair-brown, almost black near the bill; chin, throat and neck greyish-white, faintly centred with brown streaks and barred with black on the lower nape and hindneck; scapulars and lesser wing-coverts barred ashy-grey and black, narrowly fringed with grey and the subterminal black bar glossed with green; upper tail-coverts and tail pale buffy-grey, purer grey at the tip, barred broadly with mottled black and dark ashy-grey; outer tail feathers with chestnut replacing the grey on the inner webs; quills brown, the outermost primaries edged and barred with pale buff on the outer webs and mottled and barred on the inner web, mottlings increasing on the inner secondaries; these have a broad subterminal bar of black and a less well-defined second bar; greater and median wing-coverts more buff, sometimes almost rufous; below greyish-white, more or less tinged posteriorly with rufous buff; foreneck and breast with concealed bars which become very conspicuous on the lower breast and flanks; the feathers of the breast also have faint brown stripes; centre of abdomen blackish, more or less mottled with buff-rufous; vent and under tail-coverts rufous; thigh-coverts dull rufous-buff. Iris golden-hazel to orange-brown; orbital skin crimson or crimson-scarlet; bill pale yellowish-brown, rarely pale brownish or bluish horny; legs plumbeous or greyish brown, sometimes fleshy-brown; toes paler.

#### *Female*

Head like the male but with ochre edges to the feathers; hindneck and nape greyish-white with bold black centres; mantle pale chestnut, each feather cream-shafted, edged grey and with bold black bars; lower back and rump ashy brown mottled with black and a little buff; tail and upper tail-coverts with alternate bands of mottled rufous and black, and bolder bars of black and buff; longer tail-coverts with more black and less buff; primaries brown barred with buff on the outer and with chestnut on the inner webs; secondaries mottled black and chestnut-brown with four broad bars of creamy buff, edged above and below with black; greater and

<sup>1</sup> Endangered species (King 1981).



**Map 13.** Distribution of eastern (E) and Humes' (H) races of the bar-tailed (B) pheasant, and of cheer (C), Elliot's (E), mikado (M), and Reeves' (R) pheasants.

median coverts mottled black and chestnut-buff with broad tips of creamy buff; chin, throat, and foreneck creamy white; breast black, the feathers edged and streaked with white; remaining lower plumage pale chestnut, edged with creamy-buff; flanks anteriorly like the breast, posteriorly like the abdomen; under tail-coverts pale rufous, slightly mottled with brown; facial skin brick-red.

#### *Immature male*

Resembles the female, but is duller, with less clear markings, and no occipital crest (Delacour 1977).

#### **Identification**

##### *In the field* (38–40 in.)

This species is associated with hilly, broken grassland country, and usually occurs in small flocks. The distinctively elongated and buffy brown tail, and the short, pointed crest are distinctive; the bar-tailed pheasant is the only remotely similar species that possibly overlaps the extreme eastern end of the

cheer pheasant's range. The birds have many vocalizations, including a very distinctive crowing, *cher-a-per, cher-a-per, cher, cher, cheria, cheria*. They also utter cackling sounds of repeated *waaak* notes and a sharp alarm note, *tuk, tuk*. . . . Wing-whirring is lacking in this species.

##### *In the hand*

The long (300–600 mm) and strongly barred tail, together with a straight and tapering brown crest that is directed posteriorly provides an easy combination of traits for in-hand identification. No other long-tailed pheasant is so uniformly buffy-brown in body and tail colouration.

#### **Ecology**

##### *Habitats and population densities*

This species occurs over a rather wide altitudinal range in the western Himalayas, and is particularly associated with steep, grass-covered hillsides having



scattered trees, especially where rocky crags are also present. Tall grasses, rather than heavily grazed grasslands, are also preferred, and in Himachal Pradesh its altitudinal range is from about 1200 to 3000 m, or from the subtropical pine forests to the subalpine meadow zones (Gaston *et al.* 1981). In one small wildlife sanctuary (Chail) of this general area a spring density of about six pairs per km<sup>2</sup> was estimated in 1979 (Gaston and Singh 1980). A more recent survey of the same area in 1983 provided a density estimate of about seven pairs per km<sup>2</sup> (Garson 1983).

In Pakistan this species is now apparently extirpated (Severinghaus, Mirza, and Asghar 1979). Its original habitat there evidently consisted of long grasses, thick bushes, precipitous slopes, and tiered cliffs, judging from early literature.

In west-central Nepal, near the eastern edge of the species' range, the birds have been observed at elevations of about 2200–2440 m, in open scrubby forest and grassy cliffs. A spring estimate of the population density (using male calls as an index) there provided a figure of about eight pairs per km<sup>2</sup>, based on extrapolation of a small area of only 0.5 km<sup>2</sup> (Lelliott 1981a).

Population density estimates of this species are facilitated by the prolonged (September to May in Himachal Pradesh) calling period, and the fact that evening calling seems to be as prevalent as morning calling (Gaston 1981b). However, perhaps only at the peak of the breeding period are the birds all distributed as pairs rather than as flocks, and thus actual numbers may be difficult to determine in this manner.

#### *Competitors and predators*

Probably few species of pheasants are direct competitors of the cheer, since it occupies a rather distinctive vegetational stratum, and its strong digging feeding behaviour is more like that of an eared pheasant or a monal than that of most other pheasants. It broadly overlaps in altitudinal and ecological range with the Himalayan monal and the koklass pheasant, but both of these species tend to occupy heavier cover than does the cheer.

Severinghaus *et al.* (1979) list a variety of bird and mammal predators that occur within the historic range of the cheer pheasant, but none was noted specifically as having been known to take this species. It would seem likely that foxes, jackals, and some of the larger raptors such as Bonelli's hawk-eagle (*Hieraaetus fasciatus*) and booted hawk-eagle (*H. pennatus*) might represent the most serious threats to adult birds.

### **General biology**

#### *Food and foraging behaviour*

Beebe (1918–1922) noted that although in two out of 'a few' birds that he examined, he found an abundance of small leaves, finely ground up, in general he subscribed to the belief that most of their food comes from digging with their bills, during which they obtain grubs, terrestrial tubers, and the like. He did find the larvae of cockroaches as well as several wireworms in one crop, and observed birds chasing winged insects as well. Ali and Ripley (1978) suggested that their major foods are roots and tubers, seeds, and berries, with grain eaten when it is available, as well as various insects and grubs.

Foraging is typically done in pairs or sometimes in family groups. Like the Himalayan monal, a single bird or pair may dig a foot or more below the surface, until they are almost hidden from view, looking up every few seconds for possible danger (Beebe 1918–1922).

#### *Movements of migrations*

Almost certainly there are major changes in altitudinal distribution in this species, judging from its broad vertical range, but the data of Gaston *et al.* (1981) are apparently insufficient to document this seasonal shift. Baker (1930) stated that in cold weather they may be seen as low as 4000 ft, and in summer at 10 000 ft or higher, but on average are to be found between 6000 and 9000 ft. Apparently the birds move around a good deal on their particular hills, but never completely abandon them, and year after year are likely to be found in much the same places.

#### *Daily activities and sociality*

These birds feed in mornings and evenings, and unless the day is very cloudy they remain under cover during the middle of the day. During the night they have been reported to roost on the ground by some observers, but probably more generally they tend to roost in stunted trees, high bushes, or on the summits of high rocks that typically abound in their favoured habitats (Baker 1930). Ali and Ripley (1978) reported that the birds typically roost in patches of oak forests associated with gullies, and as they approach these areas in the evening they are surprisingly noisy, seemingly rendering them vulnerable to poachers or predators.

Like the monogamous eared pheasants, these birds tend to be fairly gregarious, and where population densities permit they are likely to be found in flocks of from five to 15 birds, except during the actual breeding period. Much male calling goes on within these flocks, so it is apparent that it cannot

serve as a territorial signal under such cases, and must have other social functions, which remain to be learned.

### **Social behaviour**

#### *Mating system and territoriality*

All authorities are agreed that this species is entirely monogamous, although the length of the pair bond under natural conditions is unknown. Apparently both sexes often perform crowing behaviour both at daybreak and again at dusk, and the call is loud enough to be heard for at least a mile (Baker 1930).

Territory sizes are still unstudied, but Lelliott (1981a) reported hearing four different individuals calling in mid-May, when most or all birds would be breeding, on an area of only 0.5 km<sup>2</sup> (50 ha). Thus, their territories could average no larger than about 12 ha, assuming that these were four breeding males doing the calling.

#### *Voice and display*

The crowing call, uttered by both sexes, is a loud and rather complex call that has been variously rendered, such as *chir-a-pir*, *chir-a-pir chir chir*, *chirwa*, *chirwa*. The call is uttered by the male with his head pointing directly upwards, in the manner of an eared pheasant, and begins with a series of harsh grating notes in rapid succession, which rise to a crescendo of very high pitched disyllabic whistles (Wayre 1969). Males in captivity often call in duet with eared pheasants, and the calls are sometimes difficult to distinguish, according to Wayre. He also stated that the males' visual display is a lateral one, that is somewhat similar to the posture assumed by true pheasants (*Phasianus*), with the elongated tail being spread widely and tilted toward the female in a manner that also resembles that of *Syrnaticus*. Tidbitting calls and behaviour are not yet described; nor is copulatory behaviour. Apparently the long occipital crest is never raised in the manner typical of the koklass, and the facial wattles are only moderately enlarged. They are also said to lack wing-whirring displays (Delacour 1977).

The absence of iridescent colouration in this species is of interest, and is perhaps related both to the reduction of sexual selection pressures associated with monogamy, and also with the relatively open and grassland-dominated substrate of this species, which seems to be admirably coloured for maximum visual concealment in such habitats.

### **Reproductive biology**

#### *Breeding season and nesting*

The breeding season apparently extends from late April to early June, with nesting in lower altitudes

often beginning near the end of April, and some birds as late as early June at the highest elevations. Clutch-sizes are relatively large, with 9 to 10 apparently being the usual size, but as many as 13 or 14 have sometimes been reported from nests in the wild.

The nests are typically located at the foot of a boulder on steep hillsides covered with open oak or pine forests, and usually well hidden in grasses, bushes or bracken in very broken ground. Some nests have been found at the foot of nearly vertical cliffs, and in relatively inaccessible sites (Baker 1930).

In captivity, the birds lay clutches of from 9 to 12 eggs, and from 15 to 25 eggs in a season (Delacour 1977). The incubation period is 26 days.

#### *Incubation and brooding*

All the incubation is performed by the female, although the male remains close at hand. After hatching, the male joins the family, and takes an equally strong role in protecting it from any disturbance as does the female.

#### *Growth and development of the young*

Baker (1930) cites a Mr A. Winbush, who encountered a family of newly hatched cheer pheasants. As the young scattered in all directions the two adults rushed toward him with their tails spread, their wings arched, and their neck feathers ruffled, the male bird approaching within 8 ft and continuing to threaten him until all the chicks were hidden in the grass. At that point both the adults began to walk away, calling to the chicks all the time. Probably such family groups remain intact through the winter and until the start of the next breeding season, and may be the basis for the usual covey size of five to 10 or 15 birds. Sexual maturity is attained the year following hatching.

### **Evolutionary history and relationships**

Delacour (1977) believed that this species is fairly isolated, with varying degrees of similarity to *Syrnaticus*, *Phasianus*, *Lophura*, and *Crossoptilon*. The downy plumage pattern is quite distinctive and somewhat partridge-like, and the monomorphic adult plumage is also relatively unusual. In calls and posturing it has some distinct similarities to the eared pheasants, but otherwise seems much closer to *Syrnaticus* in most respects. I have no strong opinions about the relationships of *Catreus*, and, like Delacour, believe it to be fairly isolated from other genera.



### Status and conservation outlook

This species is considered endangered in most of its range, and extirpated from Pakistan (King 1981). In Nepal it is not believed to occur within any protected areas (Lelliott 1981*a*), but it seems to be tolerably well distributed in western Nepal (Gaston 1981*a*; Roberts 1981). It also occurs in Himachal Pradesh in India, and, at least in the former location, the population probably numbers more than a thousand pairs, according to Gaston *et al.* (1981). Generally these are rather irregularly and locally distributed, with fairly good populations still present in the Chail Wildlife Sanctuary, the Budhil Nalla area, the Kajjia-Chamba area, and the upper Beas River Valley. The status in Uttar Pradesh is much less understood, but it seems likely that several thous-

and birds must be present in total. The species seems fairly resistant to disturbance, sometimes occurring fairly close to villages, but these local populations are typically small and difficult to protect (Gaston *et al.* 1981). Heavy grazing and burning of its favoured grassland habitats are one of the factors contributing to the species' decline, and the sedentary nature of the birds makes them fairly susceptible to being shot out locally by overhunting.

Some hand-raised birds have been released in Himachal Pradesh on a forest reserve near Simla, but the results of these efforts are still not very clear. Even in protected areas in India poaching remains a serious problem (King 1981). In Pakistan a few birds were released in 1978, and 30 more were put out in 1979 in the vicinity of Dhok Jiwan (Mirza 1981*a*).

# 10 · Genus *Syrmaticus* Wagler 1832

The long-tailed pheasants are small to medium-sized montane pheasants in which sexual dimorphism is well developed; and in which the tail is greatly elongated and strongly barred, but both sexes lack crests or ear-tufts. The orbital wattles are red, small to moderate in size, and of smooth texture. Males lack ruffs and their rump feathers are rounded to squarish and often conspicuously patterned, but not disintegrated. The tail is flat, highly graduated, and spread laterally in display. There are 16–20 rectrices, with the central pair sharply pointed and ornamentally barred, but without lateral fringes. The tail moult is phasianine (centripetal). The wing is slightly rounded, with the tenth primary longer than the first, and the seventh the longest. The tarsus is fairly long, and is spurred in males. Females are mostly strongly marked with brown, black and white, with white often extensive on the sides and flanks and as shaft-streaks dorsally. Five species are recognised.

## KEY TO SPECIES (AND SUBSPECIES OF MALES) OF *SYRMATICUS* (in part after Delacour 1977)

- A. Dominant colour of plumage dark brown (females).
  - B. Throat and foreneck black: Elliot's pheasant.
  - BB. Throat and foreneck not black.
    - C. Throat and foreneck buffy yellow: Reeves' pheasant.
    - CC. Throat and foreneck pale brown.
      - D. Upper back with arrow-like white shaft-streaks.
        - E. General colour rufous brown: bar-tailed pheasant.
        - EE. General colour olive brown: mikado pheasant.
      - DD. Upper back lacking white shaft-streaks: copper pheasant.
- AA. Dominant colour of plumage not dark brown (males).
  - B. Plumage mostly dark blue: mikado pheasant.
  - BB. Plumage mostly coppery red or yellow.
    - C. Back buffy yellow, with black feather-edging: Reeves' pheasant.
    - CC. Upper back coppery red.
      - D. Lower back black and white.
        - E. Sides of neck bluish black: bar-tailed pheasant.<sup>2</sup>
        - EE. Sides of neck whitish grey: Elliot's pheasant.

DD. Lower back coppery red and white: copper pheasant.<sup>2</sup>

E. Margins of rump and upper tail coverts white.

F. Margins of scapulars purplish black, tail predominantly dark brownish red, lower rump virtually entirely white: Iijima's copper pheasant (*ijimae*).

FF. Margins of scapulars white; tail predominantly cinnamon and buffy; brownish bases of white lower rump feathers visible: scintillating copper pheasant (*scintillans*).

EE. Margins of scapulars and tips of lower back and rump feathers golden; tail very dark brownish red: Soemmering's copper pheasant (*soemmeringi*).

## REEVES' PHEASANT

*Syrmaticus reevesi* (J. E. Gray) 1829

Other vernacular names: bar-tailed pheasant; faisan vénéré (French); Königfasan, (German); chi-ky (Chinese).

### *Distribution of species*

Northern China in the hills or mountains from south-west Manchuria (Jehol), Inner Mongolia (southern Chahar), and western Hopeh, southward through Shansi and Honan to Anhwei and northern Hupeh, and east to north-east Szechwan and southern Shensi, occurring in open woodlands with evergreen or deciduous trees such as pines, cypresses, thujas, and oaks, nesting in tall grass or bushes such as azaleas (Vaurie 1965). See map 13.

### *Distribution of subspecies*

None recognized.

## Measurements

Delacour (1977) reported that males have wing lengths of 275–300 mm, and tail lengths of 1000–1600 mm, while females have wing lengths of 235–250 mm, and tail lengths of 360–450 mm. Cheng *et al.* (1978) noted that five males had wing lengths of 262–272 mm, and tail lengths of 1020–1368 mm, while a single female had a wing of 218 mm and a tail of 330 mm. Thirty females aver-

<sup>1</sup> See text for racial distinctions.

<sup>2</sup> Two dubious races (*intermedius* and *subrufus*) are excluded from this key.



aged 949 g (33.5 oz), while 24 males averaged 1529 g (53.5 oz) (Knoder 1963). The eggs average  $46 \times 37$  mm, and their estimated fresh weight is 34.8 g.

### Description (after Delacour 1977)

#### Male

Crown white surrounded by a black band that also covers the forehead, lores, cheeks, ear-coverts, eyebrows, and nape; patch under the eye, throat and neck white; face feathered except for a narrow band above and behind the eyes, the skin of which is red and dotted with black plumules; the red skin is also visible on the face; mantle, back and rump clear buffy yellow, each feather with a deep black border; wing-coverts white with broad black and deep chestnut borders; tertials and secondaries barred white, black, and chestnut, with a broad buffy yellow tip bordered with black and dark chestnut; primaries blackish brown barred with rufous brown; tail of twenty rectrices, the two very long central pairs being silvery white with many crescent-like bars of black and deep chestnut along the shaft, and broad cinnamon yellow margins; the three following ones similar, but the yellow margin very wide and confined to the outer web, the five short outer ones almost entirely yellowish cinnamon vermiculated with dull black on the inner web; a black and chestnut collar on the upper breast, separating the white neck from a narrow band of buffy yellow, black-bordered feathers; breast and sides of body chestnut barred with black and white; flanks buffy yellow and deep cinnamon; abdomen, vent, thighs, and under tail-coverts black. Iris brown; bill greenish horn, legs grey to brown; spur short and stout.

#### Female

Crown, nape, ear-coverts, and cheeks mottled rufous buff, greyish and dark brown; sides of face, wide eyebrows, lores, chin, throat, and neck yellowish buff, deeper on the foreneck; a narrow stripe of naked skin covered with blackish plumules above and behind the eyes; mantle boldly mottled black and dark chestnut with large arrow-shaped white markings; back and rump greyish brown vermiculated with blackish; wing-coverts mottled and vermiculated greyish brown, the tail long and pointed, like the back in colour but the rectrices irregularly barred with pale buff and dark brown, the shorter ones with much plain chestnut and black and white tips; upper breast mottled greyish brown, blackish and white; lower breast, sides and flanks boldly mottled pale chestnut, grey and white; abdomen and under tail-coverts pale buff. Iris brown; bill horny; feet grey to brown.

#### Juvenile

Like the female but paler and duller, the throat and neck whitish, the breast light brown streaked with white.

### Identification

#### *In the field* (28–80 in.)

This species is associated with wooded and hilly areas of central China, and males are easily recognized by virtue of their enormously long (to 60 in.), barred tail, and their strongly patterned black-and-white head. Females somewhat resemble those of the common pheasant, but have a more bicoloured head pattern, with buffy stripes above the eyes, and a buffy throat and neck that contrasts with a darker crown and ear-patch. Vocalizations include a twittering chuckle, and males repeatedly utter short, piping notes.

#### *In the hand*

The very long, barred tail, and the black-and-white head pattern of males make confusion with other species unlikely; only the Elliot's pheasant has a remotely similar appearance, and in that species the throat and foreneck are blackish rather than white. Females resemble those of several other *Syrmaticus* species, but are unique in having a buffy throat and foreneck, and an equally conspicuous pale stripe above the eyes. Their tails are also longer (360–450 mm) than those of other *Syrmaticus* species. Young males are female-like, with more whitish throat markings.

### Ecology

#### *Habitats and population densities*

According to Cheng (1963), this species occupies an altitudinal range in China from 300 to 1800 m, typically occurring in valleys having steep-sided canyons, and where clustered cypresses, pines, or other coniferous trees are to be found.

In a release site in Ohio (a 35-acre island in Tappan Lake, Harrison County), adult birds were found initially to use only wooded portions of the island rather than the more grassy and shrubby areas, at least prior to late July, when dense ground cover and ripe blackberries had covered the more open areas. The nests were all located in the woody rather than the grassy and shrubby areas (Knoder and Bailie 1956).

There are no estimates of population densities under native conditions, but 6 males bred with at least 11 females on the 35-acre island just mentioned, indicating an approximate breeding density of two acres per bird.

*Competitors and predators*

There is no definite information of this in China, but predation on pen-raised birds in the United States was seemingly high (Korschgen and Chambers 1970; Seibert and Donohoe 1965), with avian predators such as great horned owls (*Bubo virginianus*) evidently an important mortality source.

**General biology***Food and foraging behaviour*

Relatively little is known of this species' foods in China, but they are known to include legumes, acorns, wild persimmons, radishes, vegetables, and liliaceous tubers (Cheng 1963). There are several studies of released birds in the United States that indicate a wide diversity of foods consumed. Seibert (1965) reported that the birds consumed wheat, wild cherries, raspberries, brome grass, dogwoods, wild yams (*Dioscorea*), crabgrass, and greenbriers (*Smilax*) as major foods in Ohio. Stephens (1966) noted that in Kentucky the birds ate acorns, hawthorn, persimmon (*Diospyros*), panic grass, black gum (*Nyssa*), lespedeza, pokeweed (*Phytolacca*), blueberries, blackberries, waste corn, and wheat, as well as such insects as grasshoppers, beetles, and caterpillars. Korschgen and Chambers (1970) found that in Missouri the birds concentrated especially on sorghum, soybeans, and maize, with these food sources comprising over half of the annual diet analysis, plus small amounts of such items as acorns, wheat, grasses and sedges, green forbs, blackberries and cherries, and a very large number of minor plant foods, totalling well over 100 different types. Animal materials, primarily of grasshoppers, comprised only about five per cent of the estimated annual diet. These food selections seemed to be governed largely by a limited variety of choice native foods.

*Movements or migrations*

These birds appear to be highly sedentary in their native China, and at least in the southern parts of their range seem to show no tendencies toward a seasonal altitudinal migration. In the more northern areas their movements are probably more irregular, and influenced by snowfall patterns (Beebe 1918–1922).

*Daily activities and sociality*

At least in North America, these birds have been found to roost preferentially in second-growth, pole-sized trees associated with a general absence of ground cover. During winter, the birds usually roost in upper ravines and on south- and east-facing slopes. The roost sites are from 3 to 20 ft or more in

height, and on horizontal limbs offering easy escape routes. Several birds may roost in the same tree or in nearby trees, but they do not roost side by side (Korschgen and Chambers 1970).

Foraging is apparently done in the usual morning and afternoon pattern typical of most pheasants, and the birds also visit sources of grit, such as roadsides. Although gregarious during the winter months, in spring these flocks disperse and form groups of two or three birds, usually either a pair or a male and two females (Cheng 1963).

**Social behaviour***Mating system and territoriality*

Although some authors have suggested that this is a monogamous species (Korschgen and Chambers 1970), there would seem to be reasons for considering it at least facultatively polygynous, given the considerable size dimorphism of the sexes, the substantial sexual plumage differences, and the apparent lack of interest of the male in tending for the young. Knoder and Bailie (1956) reported that on an island where only six males were released, at least eleven females nested, and the fertility rate of the eggs in nine of the nests found was 68 per cent, suggesting a rather high level of successful mating. However, it is not as high a fertility rate as is typical, for example, of wild ring-necked pheasants having similar sex ratios.

Little is known of territoriality in this species. Knoder (1955) did not observe territorial behaviour in a large pen initially containing 20 males, but when these were reduced to eight in early April the pen became approximately divided in half, with three males defending each of the two halves as apparent groups, and the two remaining subordinate males being submissive to all of the others. Fighting was sometimes observed along the boundary separating the three-male groups, but not among the grouped males.

*Voice and display*

Advertisement of territory or self-assertiveness of males is attained by a combination of wing-whirring and calling. Typically a bout of wing-whirring is followed by a series of high-pitched chirping calls that may be audible for up to about 200 yd (Knoder, 1955).

Postural display before a female is rather distinctive. The male will typically approach the female slowly and in concentric circles, while erecting the contour feathers and walking in a rather stiff-legged manner. After approaching to within about 6 ft, a lateral display is performed, with the tail erected and



spread. This display may be maintained until the female moves, at which time the male changes to a more directly frontal display, performing a series of stiff-legged bounds toward the female, and usually ending up about a foot from her (Knoder 1955). During the hopping movements the folded far wing is tilted upward somewhat, thereby increasing the visible surface of the bird to the female's view (Kruijt 1962b).

## Reproductive biology

### *Breeding season and nesting*

Almost nothing is known of the breeding season of this species in China. One nest of eight eggs was found in an azalea thicket on a hillside that also was covered by grassy areas, dwarf bamboos, and a sparse growth of pines (Beebe, 1918–1922). In Ohio, the egg-laying period of nine free-ranging females was from 7 April to 7 May, and the peak period of hatching was from 21 to 31 May. There was no indication of renesting in this small sample (Knoder and Bailie 1956). Of 16 nests found on a 35-acre island, nine were in second-growth saplings and brush, four were in sweet clover, rape and timothy cover, and three were in broom-sedge (*Andropogon*) (Knoder 1955).

### *Incubation and brooding*

Incubation is performed by the female alone, and there is no evidence that the male remains close at hand or helps to protect the nest. Clutch-sizes, based on 10 nests produced by free-ranging females, averaged 9.5 eggs and ranged from six to 14 (Knoder and Bailie 1956). Of 16 females that laid their clutches during the previous year in a production-release pen, the clutch size averaged only 4.4 eggs, but a total of 118 dropped eggs were also found, suggesting a production of about 11 eggs per known laying female (Knoder 1955). No dump nests or dropped eggs were found among the free-ranging females. Incubation requires 24–25 days, based on observations in captivity.

### *Growth and development of the young*

When a hen is approached with a newly-hatched brood, she will typically utter a low call and the chicks will 'freeze'. As soon as the young are able to fly they will often flush as the female alerts them, and fly into heavy cover, or alight and run swiftly. Juveniles will often fly 50–100 yd before landing, and when only half-grown are able to fly at least 800 ft (Knoder 1955; Knoder and Bailie 1956).

Newly hatched Reeves' pheasant chicks weigh an average of slightly more than 20 g (eight averaged 21.8 g at one day old), and by the time they are 35

days of age they average almost 200 g, based on zoo-raised individuals (David Rimlinger, personal communication). They attain sexual maturity in their first year, but probably remain with their mother for much of the first winter, when adult males may also join these small flocks.

## Evolutionary history and relationships

The genus *Syrmaticus* is certainly fairly close to *Phasianus*, and one might easily argue that the two taxa should be conjoined. However, Delacour (1977) pointed out that all five species of *Syrmaticus* form a natural group quite distinct from *Phasianus*, and that the downy young are quite different in the two genera as well. Nonetheless, I think it is clear that *Phasianus* and *Syrmaticus* are not very far removed from one another in their evolutionary history. Interestingly, the Reeves' pheasant has the smallest facial skin area of any of the long-tailed pheasants, but also has the greatest development of tail feathers and the largest amount of white colouration on the head, both of which would seem to be important male signals. This species hybridizes readily with the copper pheasant, but the hybrids have reduced fertility (Delacour 1977). Hybridization with the common pheasant usually results in sterile females and males with reduced fertility (Knoder 1963).

## Status and conservation outlook

This species is extensively hunted and trapped in China, not only for food but also for the male's ornamental tail feathers. The species' numerical status in the wild is not currently known, but it seems to be adapted to a variety of open-country or second-growth habitats rather than requiring primary forest cover. Dr Eugene Knoder informed me (*in litt.*) that recent field-work by Professor Wei-Shu Hsu indicates that the species is distinctly rare, and should be added to the list of endangered species.

## BAR-TAILED PHEASANT<sup>1</sup>

*Syrmaticus humiae* (Hume) 1881

Other vernacular names: Hume's pheasant; faisán de Hume (French); Hume-Fasan (German); wit (Burma); loe-nin-koi (Manipur).

### *Distribution of species*

India to Thailand, including Assam, northern Burma and south-west Yunnan, in wet and moist temperate forests between 4000 and 10 000 ft.

<sup>1</sup> Rare species (King 1981).

*Distribution of subspecies* (after Wayre 1969; Delacour 1977)

*Syrmaticus humiae humiae* (Hume): Hume's bar-tailed pheasant. Mountains of Manipur; Naga, Patkoi and Lushai Hills, and northern Burma, west of the Irrawaddy and south to Mount Victoria.

*Syrmaticus humiae burmanicus* (Oates): eastern bar-tailed pheasant. Mountains of south-west Yunnan, northern Burma (Kachin and Shan State), and northern Thailand. See map 13.

### Measurements

Delacour (1977) reported that males of *humiae* have wing lengths of 206–225 mm and tail lengths of 400–535 mm, while females have wing lengths of 198–210 mm and tail lengths of 200 mm. Cheng *et al.* (1978) reported that three males (presumably of *burmanicus*) had wing lengths of 207–213 mm and tail lengths of 486–505 mm, while two females had wing lengths of 200–210 mm and one female had a tail length of 195 mm. One male weighed 975 g, and a female weighed 650 g. Lack (1968) reported the average adult weight of *humiae* as 1000 g while Baker (1928) indicated that males of *humiae* weigh 2 lb 6 oz (c. 1070 g). The eggs of *humiae* average  $48.7 \times 35$  mm, and have an estimated fresh weight of 32.9 g; those of *burmanicus* average very slightly less ( $46 \times 34$  mm).

### Description (after Delacour 1977)

#### Male

Resembles *elliotti*, differing mainly in the black throat, neck, and extreme upper breast, in the deep chestnut colour of the abdomen and flanks, and in the tail which is darker grey with black bars lined with dark chestnut; the crown is greenish brown and the eyebrows mixed with white; the feathers of the neck are dull black with a metallic purple subterminal patch and a blue fringe; the wings resemble those of *elliotti*, but the bluish black markings have greyish tinge; the feathers of the lower back and rump are steel blue with a narrow (3 mm) white fringe. The tail is longer. Iris brown to orange; bill horny yellow; legs grey.

#### Female

Similar to *elliotti* but generally paler and having no black on the throat, which is plain pale fulvous brown, as are usually the foreneck and upper breast which, however, can exceptionally be spotted with blackish; the centre of the breast and abdomen is barred fulvous and white, never pure white.

#### Juvenile

Like the female but duller.

### Identification

#### *In the field* (24–36 in.)

This species is associated with open areas among somewhat forested habitats, especially open oak and pine forests on rocky substrates and with light undergrowth. The dark neck colour separates males from Elliot's pheasant, the only other species that might be confused with the bar-tailed pheasant except perhaps the familiar common pheasant, which lacks white scapular stripes. Females have shorter and white-tipped tails, which are also distinctly barred with blackish. Males apparently lack loud crowing, but do perform wing-whirring displays and utter loud *chuck* notes or contact calls, as well as repeated *buk* calls in alarm.

#### *In the hand*

Males can be recognised by the combination of a long tail (at least 400 mm), which is strongly barred with grey, brown and black, and conspicuous white stripes on the scapulars and wing-coverts, plus a uniformly dark-coloured neck. Only the Elliot's pheasant, which has a whitish neck and whiter underparts, is likely to be confused with this species. Females of the two species are even more similar, but the female bar-tailed pheasant has fulvous brown rather than black on the front of the neck (sometimes spotted with blackish), and the underparts are barred with fulvous rather than being pure white.

### Geographic variation

Geographic variation among males is slight and possibly clinal. Males of the eastern (*burmanicus*) race are more purplish on the upperparts, the feathers of the lower back are deep black rather than bluish, and have wider white fringes, producing a less distinctly barred effect. Females show no obvious geographic variation (Delacour 1977).

### Ecology

#### *Habitats and population densities*

According to Beebe (1918–1922), the Hume's race of this species is found in somewhat open jungle, where the trees are primarily oaks and similar species, and where there is undergrowth and open areas of long grass, or mixed grasses and bracken. Typically there are also rock outcrops present, which may be rather scattered or so abundant that the



grassy areas form pathways among them. In altitude they were said by Beebe to range from about 2500 ft to at least 5000 ft, and usually found in the vicinity of streams. Baker (1928) reported that they range from 4000 to 8000 ft, in thin and open forest or in mixed scrub and bracken on rocky hillsides, rarely as high as 10 500 ft. He doubted (1930) that they would ever occur as low as 2500 ft except perhaps during the coldest weather, and said that they are much more associated with open forests and scrub than with lowland evergreen forests.

The Burmese race of this species has been observed between 4000 and 5500 ft in Thailand, foraging in open hill-forests of oaks or pines, and spending the rest of its time in dense evergreen forests (Diegnan 1945). In Burma the birds are said to occur between 4000 and 9000 ft, in open rather than in heavy forests as well as on grass-covered hillsides (Baker 1930).

There are no estimates of population densities.

#### *Competitors and predators*

There is no direct information on these subjects.

### **General biology**

#### *Food and foraging behaviour*

Rather little has been written on this. Baker (1930) quoted a Mr J. P. Cook as having shot a male out of some raspberry bushes, on the fruit of which it had been feeding, while on another occasion he flushed a group of eight or 10 birds from a clump of dwarf dates, on which they had apparently been foraging. A Captain Drummond informed him that the birds he had shot had been foraging mainly on small chestnuts, some kind of red berry, and occasionally on small snails.

Foraging is done at dawn and dusk, with the birds spending the rest of the day in heavy wooded cover (Deignan 1945). They also roost at night in taller forest cover (Davison 1979a).

#### *Movements or migrations*

Nothing is known specifically of this, but there are probably some altitudinal movements associated with seasonal weather changes (Baker 1930). Davison (1979a) estimated a total altitudinal range of from 2500 to 10 000 ft, and said that the birds move to the hilltops in warm, wet weather, nesting at least as high as 7000 ft.

#### *Daily activities and sociality*

Most observations suggest that these birds occur in small groups of from three to five birds outside the breeding season; these groups frequently consist of a

single adult male and varying numbers of females or immatures. Like the Elliot's pheasant, they seem to be relatively non-gregarious birds, and generally are extremely difficult to observe in their natural habitats.

### **Social behaviour**

#### *Mating system and territoriality*

It seems quite likely that this species is facultatively polygynous under wild conditions, as is the case in captivity. Nothing is known of the birds' territorial behaviour; a crowing call has been mentioned only by Beebe (1918–1922), and was not mentioned as present by Davison (1979a). He too believed that the birds are polygynous, the males living in groups of a single male and several females.

#### *Voice and display*

Davison (1979a) has provided the only available detailed description of voice and display in this species. Both sexes utter a loud *chuck*, which seems to serve as a contact call, and a repeated *buk* used as a contact call among members of a group, which in louder form seems to serve as an alarm or threat signal. There is also a screeching alarm note, and a loud hissing call uttered by males during high intensity lateral display. A tidbitting clucking call is also present.

Males advertise their presence with a wing-whirling display, the sound of which carries more than 30 m (Fig. 27). There is no loud calling associated with this display, but the display is most often performed in spring, and especially during the first hour after leaving the roost. Calling is usually performed from somewhat raised sites, which may be used repeatedly. The usual threat display is a forwardly oriented posture, with the head held low, the tail spread, and the body feathers ruffled. A lateral threat, very much like that performed by males toward females in courtship, is used between males or by females trying to avoid a courting male. The wing nearer the other individual is lowered, the farther wing is slightly raised, the tail is spread and tilted toward the other bird, and the head is held high with, in males, the wattles distended.

Courtship display among captive birds is most frequent in March and April, during the egg-laying period. During tidbitting, the male repeatedly picks up and drops a small object while clucking, which typically brings the female on the run. Two male displays are then performed, the lateral and frontal. Lateral display resembles that just described for threat, but the head is held lower. The male then runs in arcs before the female, always turning away



Fig. 27. Postures of the male bar-tailed pheasant, including lateral threat (A), facial engorgement (B), frontal threat (C), and intense frontal display (D). Adapted from Davison (1979a).

at the end of each run rather than turning toward the hen, as is usually the case in encounters between males. On one occasion the male was observed to veer toward the female and perform a frontal display that is very similar to the forward intense threat display of males. Similar frontal displays reportedly also occur in the mikado and Elliot's pheasants (Delacour 1977), but apparently are lacking in typical pheasants and ruffed pheasants.

Prior to copulation the male approaches the crouching hen in an erect posture, with the wattles distended and the nape feathers erected into a peak. No specific postcopulatory displays have been noted (Davison 1979a).

### Reproductive biology

#### *Breeding season and nesting*

Nests have been found in the wild between March and May, and the clutch-size of such nests has ranged from six to 10, with the average of five nests

being 7.6 eggs (Davison 1979a). In one case the nest was found at the foot of a tree, in dwarf-oak vegetation, and hidden in a small bush (Baker 1930). In captivity, females nest on the ground, typically under a shrub or in thick grass if these are available (Davison 1979a).

#### *Incubation and brooding*

Eggs are laid by captive females every second day, typically in the early evening. The normal clutch in this situation is of six or more eggs, although first-year females may produce smaller clutches (Davison 1979a). The incubation period lasts 27–28 days, and the clutch is presumably defended only by the female. There is no indication that the male participates in defence of the brood either.

#### *Growth and development of the young*

Reportedly the chicks of this species are unusually wild, and may be more difficult to rear than those of Elliot's pheasants. At least in one case, they also



grew a little more slowly than Elliot's, although the males attained their adult plumage by about five months (Delacour 1977). Sexual maturity is attained in the first year.

### Evolutionary history and relationships

As noted in the account of the Elliot's pheasant, these two species are very closely related and probably comprise a superspecies.

### Status and conservation outlook

This species is considered rare (King 1981), although its actual status in the wild is uncertain. The Burmese race has evidently been little affected by exploitation in northern Burma, and there at least the population is perhaps fairly secure (King 1981). In eastern India the nominate race has long been rare and patchy in distribution, and there have been no recent sight records (Lamba 1981). The species' status in Thailand is not currently known, but it is believed to be a rare resident in the extreme north-western part of that country.

## ELLIOT'S PHEASANT<sup>1</sup>

*Syrmaticus ellioti* (Swinhoe) 1872

Other vernacular names: Chinese barred-backed pheasant; faisan d' Elliot (French); Elliot-Fasan (German); han-ky (Chinese).

### Distribution of species

Eastern China south of the Yangtze in Kiangsi, southern Anwei, Chekiang, and Fukien (lat. 25–31° N, approximately). See map 13.

### Distribution of subspecies

None recognized.

### Measurements

Delacour (1977) reported that males have wing lengths of 230–240 mm, and tail lengths of 390–440 mm, while females have wing lengths of 210–225 mm and tail lengths of 170–195 mm. Cheng *et al.* (1978) reported that three males had wing lengths of 246–257 mm, and tail lengths of 420–470 mm, while two females had wings of 197–200 mm and tails of 176–180 mm. Seventeen males had an average weight 1156 g (range 1044–1317), and 35 females averaged 878 g (range 726–1090) (Gene Knoder, *in litt.*). The eggs average 46 × 34 mm, and have an estimated fresh weight of 30.2 g.

<sup>1</sup> Endangered species (King 1981).

## Description (after Delacour 1977)

### Male

Crown chestnut-brown, the eyebrows mixed with pale grey; cheeks and ear-coverts greyish brown; sides of neck whitish grey, the hind neck darker grey; chin, throat, and foreneck black; mantle and upper breast bright rufous chestnut, each feather having a subterminal black band and a metallic, coppery red fringe; a white bar on the scapulars; wing rufous chestnut with a broad steel-blue band on the lesser coverts; greater coverts with a black subterminal bar and broad white tips, forming a band across the wing; secondaries and tertiaries chestnut with a black subterminal bar and a white or grey tip; primaries dull brown; lower back and rump black barred with white; tail of 16 rectrices with broad bars of pale grey and rufous chestnut, separated by irregular black lines; lower breast, abdomen, and vent white, the feathers with hidden dark brown bases; thighs chestnut-brown barred with white; feathers of the flanks chestnut with broad white tips; under tail-coverts black and chestnut. Iris brown to orange; bill horny yellow; legs grey.

### Female

Crown rufous brown with blackish tips to the feathers; eyebrows, face, sides, and back of neck greyish fulvous; chin, throat, and foreneck black; mantle mottled, each feather being rufous brown with an arrow-shaped white shaft-marking and a broad subterminal black bar; scapulars fulvous brown with ashy tips; wing-coverts, tertiaries and secondaries vermiculated brown and black, with a large subterminal black patch and light greyish tip; primaries brownish black with interrupted rufous borders; lower back and rump rufous brown finely vermiculated with black; upper tail-coverts chestnut with peppered, pale brown tips, the longest with indistinct bars; central rectrices pale brown vermiculated with blackish, having indistinct chestnut bars and tip; other rectrices plain chestnut with black subterminal bars and broad white tips; tail short and bluntly pointed; upper breast mottled rufous brown with black subterminal spots or bars; feathers of lower breast, sides and flanks brown, with a white tip that becomes very broad on the abdomen which appears white; thighs brown; under tail-coverts chestnut with broad blackish borders and white tips. Iris brown; bill horny; legs grey.

### Juvenile

Like the female, but duller and throat white; young males soon show barred tail feathers.

## Identification

### *In the field* (20–24 in.).

This Chinese species is associated with thick jungle and ravine vegetation, and is very difficult to observe. The birds have the same shape as does the common pheasant, but the long tail is strongly barred with white and brown in males, and the sides of the neck are also white to greyish white. Vocalizations have not been well described, but during the breeding season the males perform wing-whirring and follow this with a loud, repeated *geke* call. Females have relatively short and blunt-tipped tails, which are tipped with white. They also are distinctly ashy-grey on the sides of the neck and in the scapular area.

### *In the hand*

Males are readily identified by their greyish white necks and their boldly barred tail pattern, with alternating brown, black and greyish white barring. The lower flanks and underparts are also uniquely white. Females are the only long-tailed (170–195 mm) pheasants to exhibit a pure white abdomen and greyish colour on the sides and back of the neck, while the front of the throat is black.

## Ecology

### *Habitats and population densities*

Natural habitats of this species are shrubby areas at moderate elevations in mountains or valleys, and dense bamboo thickets and undergrowth of sparse coniferous forests (Cheng *et al.* 1978).

Almost nothing is known of this species' life in the wild, including its population densities.

### *Competitors and predators*

Beebe (1918–1922) reported a 'half-hearted battle' occurring between an Elliot's and male ring-necked pheasant, but otherwise could learn nothing of associations of this species with any other bird or mammal.

## General biology

### *Food and foraging behaviour*

In the wild, this species has been reported feeding on seed pods, seeds, berries, and various kinds of leaves, with a few remains of ants being the only trace of animal foods found in the specimens that Beebe (1918–1922) collected.

In captivity the birds seem to do well on the normal pheasant diets (Howman 1979).

### *Movements or migrations*

Nothing is known of this in the wild, although the birds are said to be relatively poor fliers, and tend to escape on foot. They are said to remain on particular slopes throughout the entire year (Beebe, 1918–1922).

### *Daily activities and sociality*

These birds seem to be much like typical *Phasianus* in their normal daily activities. Beebe (1918–1922) found a roosting site of male in the interstices of the balustrade of an ancient Chinese grave. Foraging is done during the daytime hours, probably in the usual morning and late-afternoon manner, apparently in pairs or at most in small family parties.

In captivity the birds exhibit no indications of social interplay, even when kept in large flocks. Instead they seem to operate as solitary and individual birds, with very little vocal communication (Knoder 1983).

## Social behaviour

### *Mating system and territoriality*

Nothing is known of this in the wild, but in captivity the most effective sex ratios for high fertility seems to be approximately between one and two females per male. With sex ratios of three to five females, fertility was found to drop as much as 24 per cent (Knoder 1983). Presumably the species is also polygynous in the wild.

There is no clear information on territorial sizes, but in small pens male Elliot's pheasants regularly fight, with one bird eventually killing all the others. Even in pens as large as about 46 × 61 m the dominant male was found to require a great deal of room in relation to the pen size (Knoder 1983).

### *Voice and display*

The vocalizations of this species are 'relatively primitive and uncomplicated', and consist mostly of low clucks and chuckles. Both sexes utter a shrill but not loud squeal, and this call is used by males during the breeding season as an apparent threat to males in nearby pens. The male's wing-whirring display is a rapid but relatively silent display that is nearly identical to that of the Reeves' pheasant, the firebacks, and the kalij (Knoder 1983). This display has been illustrated by Steinbacher (1941; see Fig. 28). This wing-whirring is commonly followed by a repeated *geke* call (Cheng *et al.* 1978). The usual display to females is a lateral one, with the neck extended, the body feathers ruffled, and the tail spread and tilted toward the female (Wayre 1969). In this species, as well as in such relatives as the mik-





Fig. 28. Postures of male Elliot's pheasant, including normal standing posture (A), facial engorgement (B), lateral display to female (C), and wing-flapping (D). After various sources, including Schenkel (1956–58).

ado and the bar-tailed pheasants, the under tail-coverts of one or both sexes may function as a warning or following signal (Davison 1976). Tidbitting behaviour and calling is as yet only poorly described, although Beebe (1918–1922) reported that a male will often call to the hen in a low voice when picking up grain, and then spread his tail and flatten his plumage while also swelling his wattles as she approaches.

## Reproductive biology

### *Breeding season and nesting*

Nothing is known of this species' breeding season in the wild. However, in North America the birds were observed in Ohio to begin laying between 10 and 20 March, and reach a peak in laying about the middle of April. By the end of May nearly all egg-laying had terminated, although a few eggs were laid as late as 10 June. Eggs were laid every second day on average,

and over the course of a single season females were found to lay an average of 14.3 eggs, but with a maximum of 61 eggs laid by two females in a single pen (Knoder 1983). Typical clutch sizes in captivity are from six to eight eggs.

### *Incubation and brooding*

Presumably only the female is involved with incubation and tending for the young, although this is not known for free-living birds. Under artificial conditions the incubation period requires 26 days, and Knoder (1983) reported a hatchability of 68 per cent for more than 2500 fertile eggs, and a fertility rate of about 52 per cent for nearly 5000 eggs.

### *Growth and development of the young*

The chicks of this species are relatively easy to raise, and they attain adult plumage at about 16–18 weeks of age (Knoder 1983).

At the San Diego Zoo, 15 newly hatched chicks weighed an average of 21.5 g, and when a month old

averaged 127 g. Four juvenile males averaged 688 g at 90 days, and two juvenile females averaged 525 g at the same age (David Rimlinger, personal communication).

### Evolutionary history and relationships

This species is clearly a very close relative of the bar-tailed pheasant, and somewhat less obviously shows similarities to the copper pheasant. However, a fairly recent separation of bar-tailed and Elliot's pheasant ancestral stock can be readily visualized in the eastern Himalayas, perhaps during early Pleistocene times, as temperate or montane forest areas were being disrupted by climatic changes.

### Status and conservation outlook

This species is currently considered endangered (King 1981), and is believed to be becoming increasingly rare in the wild as a result of habitat destruction. There is no good recent information on its status in the wild, but apparently wild-trapped birds are still fairly common in Chinese zoos. Several nature sanctuaries have been established within the historic range of the Elliot's pheasant, although its actual status in these remains unknown (Knoder 1983). Efforts are currently under way to census and build up captive populations of this species, and it would seem that this is one species that can be rather readily bred in large numbers under captive conditions, with low fertility one of the few problems associated with this approach, according to Knoder.

### MIKADO PHEASANT<sup>1</sup>

*Syrnaticus mikado* (Ogilvie-Grant) 1906

Other vernacular names: None in general English use; faisan mikado (French); Mikadofasan (German).

#### *Distribution of species*

Limited to the central mountains of Taiwan (Formosa), between 6000 and 10 000 ft (Delacour 1977). See map 13.

#### *Distribution of subspecies*

None recognized.

### Measurements

Delacour (1977) reported that males have wing lengths of 210–230 mm and tail lengths of 490–530

mm, while females have wing lengths of 187–215 mm and tail lengths of 172–225 mm. Two males averaged 1300 g, while two females averaged 1015 g (various zoo records). The eggs average 55 × 39 mm, and have an estimated fresh weight of 46.2 g.

### Description (after Delacour 1977)

#### *Male*

Head and neck bluish purple, the hidden base of the feathers dull black, mantle and breast glossy purplish blue spotted with black, each feather being dull black with a broad steel-blue border and a sub-terminal arrow-shaped shining black patch; lesser wing-coverts, lower back, and rump deep black with metallic blue borders to the feathers, some of these borders being partly or completely white on the rump of some specimens; greater wing-coverts black with broad white tips, forming a conspicuous bar; secondaries and tertials black with small white tips; primaries brownish black; tail of sixteen rectrices, black with many irregular white bars more or less freckled with black; abdomen dull black; under tail-coverts black with narrow white tips. Iris reddish brown; bill black above, the lower mandible and tip pale horny yellow; legs dark grey.

#### *Female*

Resembles *humiae*, but darker and more olive brown; above like *humiae*, but white markings on mantle usually larger, chestnut parts of the central rectrices more extensive, and black spots deeper and bigger; all rectrices coarsely barred throughout; underparts earthy brown with large arrow-shaped white markings bordered with blackish on breast; abdomen and flanks coarsely mottled white, brown and blackish; thighs brown. Iris light brown; bill and feet as in the male, but paler.

#### *Juvenile*

Like the female, but head, throat, and neck spotted with buffy white; the males can very soon be distinguished by their black and white tail feathers (which are chestnut, tipped with black and white, in females).

### Identification

#### *In the field* (20–32 in.)

Limited to the island of Taiwan, where it is very rare, this species is unmistakable owing to the male's very long and barred tail and otherwise generally blackish colouration. Females also have a pointed but shorter tail, which is barred with black, brown, and white, and otherwise are generally olive-

<sup>1</sup> Vulnerable species (King 1981).



brown above and mottled with white below. The birds are found in small groups and are normally quite silent, although during the breeding season the male utters a shrill and drawn-out whistle, *chiri*. Repeated chuckling sounds have also been reported.

#### *In the hand*

The purplish-black plumage of the male, interrupted on the tail and rump with narrow white barring is distinctive. Females resemble those of other *Syrmaeticus* species, especially the bar-tailed pheasants, but are darker and more olive-brown, with white markings more extensive on the mantle and the black and chestnut barring on the tail feathers more conspicuous.

### Ecology

#### *Habitats and population densities*

This species is found at elevations from 1600 to 3300 m in thick forests having a dense undergrowth of rhododendrons and bamboo, but is adaptable to a variety of primary and secondary forest habitats (Severinghaus 1977, 1978). In much of its range the cliffs are precipitous and relatively inaccessible (Wayre 1969), and have limited the extent of lumbering deforestation. Evidently the birds prefer areas with slopes greater than 40°, and with a dense undergrowth of bamboos, other grasses, and ferns (Severinghaus 1977).

There are no detailed estimates of population densities, but Poltack (1972) stated that local loggers in one area estimated that about 200 birds occurred in one forest area of three square miles, suggesting a very high density of nearly 70 birds per square mile, or about 25 per km<sup>2</sup>.

#### *Competitors and predators*

This species occurs with the Swinhoe's pheasant and the common pheasant in Taiwan, but probably has very little contact with either, especially the latter.

There is little information on possible predators, which are perhaps most likely to consist of large, forest-adapted raptors. Mr W. Goodfellow, who first discovered the species, judged that martens were probably the species' major enemy (Beebe 1918–1922).

### General biology

#### *Food and foraging behaviour*

There is no detailed information on this from wild birds, but in captivity the birds seem to be rather typical pheasants, in spite of an early suggestion that

they require considerable amounts of green food in their diet (Howman 1979). Wayre (1979) stated that the birds are most often observed in April and July, when the wild fruits and seeds upon which they feed are ripe. These foods were said to include strawberries, asters, ferns, and the like, while during the rest of the year the species is said to feed on insects as well as on the shoots and buds of plants.

#### *Movements or migrations*

There is no information on this, but other than possible altitudinal movements with the seasons these are probably very limited.

#### *Daily activities and sociality*

These birds occur in areas of locally heavy rainfall, and during such rainfall they evidently perch in trees, rather than coming down to the ground to feed. At such times as many as nine birds have been seen perching in a single group (Poltack 1972). Otherwise, they feed in morning and evening, as do most other pheasants (Delacour, 1977).

### Social behaviour

#### *Mating system and territoriality*

At least in captivity, these birds are polygynous, with two or three females often being fertilized by a single male. Severinghaus (1977) believed that wild birds might be monogamous. There is no information available on territorial behaviour in these birds.

#### *Voice and display*

These birds are said to be rather silent, except for a shrill whistle that the male utters during the breeding season, and a quiet alarm note (Wayre, 1969). The displays of the male have recently been described by Sahin (1984), who noted that lateral (waltzing) display is present in both sexes and occurs more or less throughout the year. The male's major courtship display consists of an erect frontal display, with the tail held downward rather than raised as in the bar-tailed pheasant. This display was observed only during the mating period and only in males. Wing-whirring is also present and appears to function in territorial behaviour. Tidbitting, involving actual food presentation, is also a part of courtship behaviour.

### Reproductive biology

#### *Breeding season and nesting*

The eggs of this species are laid from the end of February until May, according to Delacour (1977),

who presumably was referring to captive birds in France. However, he also stated that they often lay three clutches of eggs between the end of March and the middle of July. Beebe (1918–1922) quoted W. Goodfellow, who judged that in Taiwan the birds nest about the end of April and early May, based on the breeding condition of females that he collected.

Few nests have been found in the wild, but Wayre (1969) noted that a forest department assistant in Taiwan told him that he had seen three or four nests, and that all of them had been constructed of bamboo stalks situated on the trunk or in the branches of a fallen tree, some 3 or 4 ft above the ground. Wayre later tested this idea with captive birds, and found that two females that were given their choice of ground or elevated nesting boxes chose the latter. It is possible that such elevated sites are adaptive in this area of heavy rainfall, which might tend to flood ground nests.

#### *Incubation and brooding*

Incubation in this species requires 28 days, and at least in captivity the normal clutch is of about five eggs. There is as yet no indication that the male participates in nest defence or in care of the young.

#### *Growth and development of the young*

When hatched, the chicks of this species are relatively large and, like tragopan chicks, are soon able to fly (Wayre 1969). This precocity is probably adaptive in the forested habitats where the birds are normally found.

Among 22 chicks hatched at the San Diego Zoo, the average weight at hatching was 30.5 g, and at a month of age the chicks averaged 112 g. Ten males weighed an average of 343 g at 60 days, while three females averaged 335 g at the same age (David Rimplinger, personal communication). The males attain their adult plumage in the first year, and initial breeding also occurs at that time. Occasionally, however, the eggs of first-year females are infertile, and better breeding results occur with two-year-old birds. Two or even three females can be maintained with a single adult male, according to Delacour (1977).

#### **Evolutionary history and relationships**

Presumably this form has been isolated from the other species of *Syrmaticus* since at least the Pleistocene, as Taiwan is located nearly 200 km from mainland China, or well beyond normal pheasant dispersal abilities. Its nearest congeneric relative, zoogeographically at least, is the Elliot's pheasant, but in general the bird gives a stronger impression of being a highly melanized version of the bar-tailed

pheasant. It seems likely that all three evolved from a common ancestral type, with the mikado pheasant locally adapting to a deeply forested habitat in which generally dark plumage colouration would be distinctly advantageous. Hybrids between mikado and Elliot's pheasants exhibit fertility only among males, suggesting a fairly prolonged period of genetic separation between them (Delacour 1977).

#### **Status and conservation outlook**

This species is currently considered vulnerable with an estimate of the population in 1975 as perhaps numbering a few thousand individuals (King 1981). Severinghaus (1978) spent two years studying this species in the early 1970s, and made several conservation proposals in 1974 for the mikado and Swinhoe's pheasants. However, these proposals have not yet been followed, and he believes that increased disturbance to the remaining mikado pheasant habitat is likely to occur. Logging has been stopped in one proposed reserve area, and the birds are also known to occur in the proposed Yu Shan National Park in central Taiwan. Several other areas were proposed by Severinghaus as preserves, but as of 1978 none of these had been approved.

### **COPPER PHEASANT**

*Syrmaticus soemmerringi* (Temminck) 1893

Other vernacular names: Soemmerring's pheasant; faisan scintillant, Faisan de Sommerring (French); Kuperfasan (German); yamadori (Japanese).

#### *Distribution of species*

Japan in Honshu, Shikoku, and Kyushu. Sedentary, occurring in coniferous forest, especially of *Cryptomeria* and cypress, and adjoining mixed forest with dense undergrowth and grassy hillsides, in rough and broken country in mountainous regions, but at elevations below 4500 ft, and also in suitable hills near the sea (Vaurie 1965). See map 14.

#### *Distribution of subspecies*

*Syrmaticus soemmerringi scintillans* (Gould): scintillating copper pheasant. Northern and central Honshu, north of lat. 35° 10' N; intergrades with *intermedius* and *subrufus*.

*Syrmaticus soemmerringi intermedius* (Kuroda): Shikoku copper pheasant. South-west Honshu and Shikoku; intergrades with *subrufus* in south-west Shikoku. Doubtfully distinct from *scintillans*.

*Syrmaticus soemmerringi subrufus* (Kuroda): Pacific copper pheasant. South-east Honshu, south





**Map 14.** Distribution of Ijima's (I), Pacific (P), Soemmerring's (S), Shikoku (Sh), and scintillating (Sc) races of copper pheasant.

of *scintillans*; also in south-west Honshu and south-west Shikoku, according to Yamashina (1976).

*Syrmaticus soemmerringi soemmerringi* (Temminck): Soemmerring's copper pheasant. Northern and central Kyushu; intergrades with *ijimae* in the south.

*Syrmaticus soemmerringi ijimae* (Dresser): Ijima's copper pheasant. South-east Kyushu.

**Measurements**

Few weights are available, but one adult of unstated sex weighed *c.* 907 g (Stephen Wylie, personal communication). The eggs (of *scintillans*) average 47.7 × 34.9 mm, and the estimated fresh weight is 32 g.

**Description (of soemmerringi, after Ogilvie-Grant 1893)**

*Adult male*

General colour above chestnut or brownish chestnut, the margins of the feathers of the mantle, chest, scapulars, lower back, and rump glossed with purplish carmine with fiery-gold reflections; the basal part of the feathers black, most noticeable on the wing-coverts; quills brownish black, the primaries mottled with rufous buff and the secondaries irregularly margined round the outer web with rufous; breast and rest of underparts resemble the wing-coverts, but the feathers are paler towards the margins; central tail feathers chestnut with wide-set narrow black bars; above each of these black bars the chestnut is of a deeper colour and becomes gradually lighter towards the next bar; outermost tail feathers chestnut, widely tipped with black. Iris brown, bill yellow-horn, legs grey (Delacour 1977).

*Adult female*

Top of the head blackish brown, each feather margined with rufous buff; back and sides of the neck and mantle rufous, shading into vinaceous towards the extremity of each feather, those of the mantle being somewhat coarsely mottled with black; wing-coverts and scapulars similar, but of a more cinnamon-coloured tint and with more strongly marked buff shaft-stripes; lower back and rump sandy rufous, finely mottled with black and with black shaft-stripes; quills very similar to those of the male; chin, throat, and forepart of neck pale buff, each feather tipped with black; chest feathers greyish rufous, paler on the breast and underparts; and all with the basal part black; upper tail-coverts and middle pair of tail feathers chestnut or rufous, indistinctly mottled with black and paler towards the margins; outer tail feathers chestnut tipped with white, and with a subterminal black band. Iris brown, bill horny, legs pale pinkish grey (Delacour 1977).

	Males		Females		Reference <sup>1</sup>
	Wing	Tail	Wing	Tail	
<i>scintillans</i>	205–230	484–752	197–219	164–196	Delacour 1977
<i>intermedius</i>	207–228	676–845	192–205	155–193	Delacour 1977
<i>subrufus</i>	205–220	635–815	192–205	164–192	Delacour 1977
<i>soemmerringi</i>	210–224	655–978	195–220	175–200	Delacour 1977
<i>ijimae</i>	205–235	640–880	195–216	144–190	Delacour 1977
All races	205–235	635–880	192–220	144–200	Delacour 1977

<sup>1</sup> Supplemented by personal observations

*Juveniles*

Resembling the adult female (Delacour 1977).

**Identification***In the field* (20–48 in.).

Limited to Japan, this species could only be confused with the other native pheasant, the green pheasant. The coppery colour of the male, and its very long, brown tail, easily allows for separation. Females have shorter, white-tipped tails with little evident barring except for a black band near the tip. Vocalizations are only poorly described, but wing-whirring is performed by males during the breeding season.

*In the hand*

The entirely coppery brown colour of the male, and the narrow black barring on the tail, is distinctive. Females rather closely resemble those of the bar-tailed and mikado pheasants, but lack arrow-shaped white shaft-streaks on the upper back, and are more cinnamon to rufous-coloured in general tone.

**Geographic variation**

Geographic variation is considerable and generally clinal, with southern populations becoming darker and more richly coloured, except that the race found in southern Kyushu (*ijimae*) has an almost entirely all-white lower back and rump, while otherwise being the darkest and most richly coloured race. There is a great deal of individual and local variation, and at least two of the subspecies might well be considered synonymous when subjected to further study (*intermedius* with *scintillans*, and *subrufus* with *soemmerringi*) (Wayre 1964). Many individuals that exhibit transitional characteristics between the subspecies occur, and Yamashina (1976) has related the origins and distributions of three of the subspecies (*scintillans*, *subrufus*, and *soemmerringi*) to variations in winter temperatures and associated snowfall.

**Ecology***Habitats and population densities*

Yamashina (1976) stated that all the subspecies of the copper pheasant inhabit wooded country, and are associated with sloping ground having tall tree cover. In the north, this includes many coniferous forests of cypress and pines, but also sometimes deciduous forests of oaks and beeches. Farther south, the birds typically inhabit broad-leaf forests of various types (*Quercus*, *Castanea*, *Castanopsis*, *Machilus*). When in pine woods, they especially

favour those with well developed undergrowths of *Lespedeza*, *Cleyera*, various ferns, and several kinds of thorny shrubs.

There are no estimates of population densities.

*Competitors and predators*

Yamashina (1976) noted that in general the copper pheasant is found in different habitats from the green pheasant, which is associated with grassy plains, farmlands, and light woodlands at low elevations. The two species mix only uncommonly, and according to Yamashina have rarely hybridized. Beebe (1918–1922) mentioned that foxes and weasels are presumptive enemies of copper pheasants.

**General biology***Food and foraging behaviour*

This species feeds primarily on acorns and mast of such forest trees as *Castanopsis*, *Machilus*, *Cleyera*, and *Castanea*, which are gathered from the forest floor. They sometimes also eat the fruits of *Cleyera*, *Lespedeza*, and thorny shrubs by flying or hopping up into the trees and plucking them. Animal foods include many kinds of insects, together with earthworms and crabs. Young birds exist primarily on animal materials (Yamashina 1976; Ogasawara 1969). Beebe (1918–1922) observed that birds he had collected or examined contained acorns in their crops as well as grubs and the chrysalids of lepidopterans.

*Movements or migrations*

There is no specific information on this subject. Beebe (1918–1922) stated that in northern Honshu the birds are forced to descend to lower altitudes, and at that time may outnumber the green pheasant in such regions.

*Daily activities and sociality*

According to Yamashina (1976), these are relatively solitary birds, and only seldom form flocks. Beebe (1918–1922) noted seeing a flock of two males and four females, apparently in mid-winter. The hen and her young are also said to remain together through the winter. Roosting is done in trees, often on steep slopes, and frequently in pines. One roosting tree observed by Beebe was used by a male and three females or young birds, which roosted no more than 15 ft above the ground.

**Social behaviour***Mating system and territoriality*

Yamashina (1976) believed that, although it has not been proven, the copper pheasant is polygynous in





Plate 31. Cheer pheasant, pair. Painting by H. Jones.





Plate 32. Siamese fireback, pair. Painting by H. Jones.



Plate 33. Hume's bar-tailed pheasant, pair. Painting by H. Jones.





CALLOPHASIS MIKADO

Plate 34. Mikado pheasant, pair. Painting by H. Jones.



Plate 35. Elliot's pheasant, pair. Painting by H. Jones.





Plate 36. Soemmering's copper pheasant, pair. Painting by H. Jones.



Plate 37. Reeves' pheasant, pair. Painting by H. Jones.



Plate 38. Manchurian common pheasant, pair. Painting by H. Jones.





Plate 45. Germain's peacock pheasant, pair. Painting by H. Jones.



Plate 46. Malayan peacock pheasant, pair. Painting by H. Jones.



Plate 47. Bornean peacock pheasant, pair. Painting by H. Jones.



Plate 48. Palawan peacock pheasant, pair. Painting by H. Jones.









ARGUSIANUS ARGUS

*(Red Argus: Malay argus: Tinian argus: M. Davison's Argus: Argus of the Malay Peninsula)*

Plate 50. Malay great argus, pair. Painting by H. Jones.



the wild. However, Beebe (1918–1922) judged the birds to be monogamous as often as they might be polygynous, and said that he had known of reports of males associating with a hen and her brood, suggesting monogamy.

Territory sizes are as yet unestimated, but Yamashina (1976) reported that the males are highly territorial in spring, with a single male monopolizing a 'whole valley'. Evidently ridges may form natural boundaries to territories, judging from his account.

#### *Voice and display*

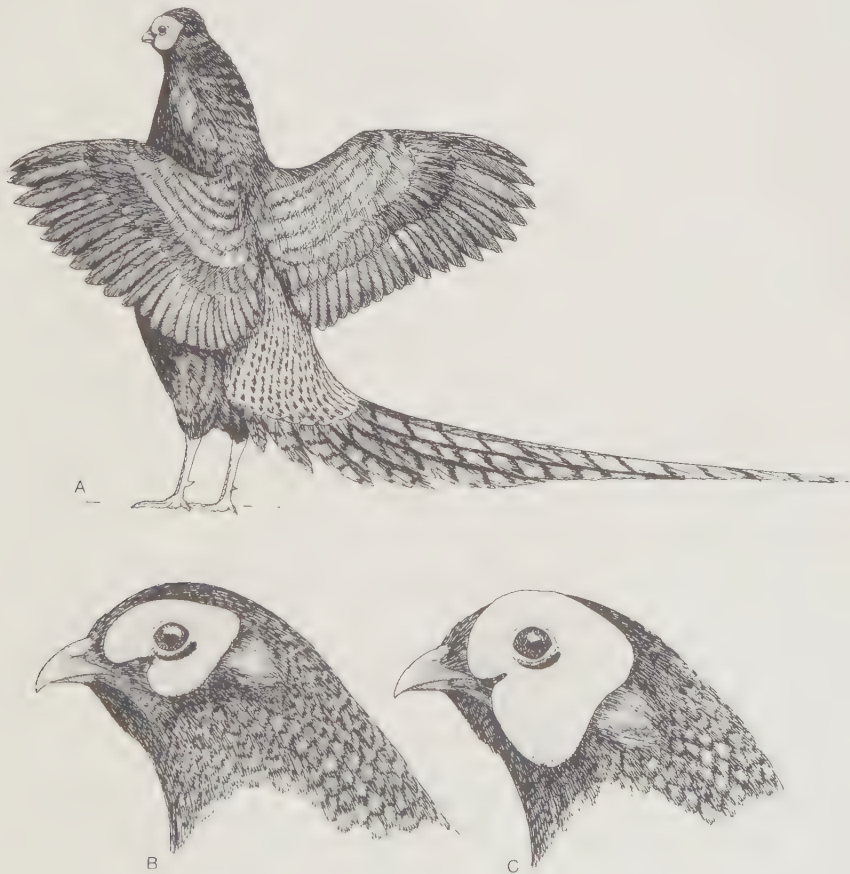
At the start of the breeding season, male copper pheasants begin their wing-whirring display (Fig. 29). This produces a loud drumming noise that is audible for a considerable distance. Crowing also occurs during the mating season, during morning and evening hours (Beebe 1918–1922). However, Delacour (1977) reported that wing-whirring occurs without the calling. Wattles of the male can be engorged to some degree, but apparently not to the extent typical of *Phasianus*.

Almost nothing has been written of the postural displays of this species, which presumably are much like those of the bar-tailed pheasant, for example. This is the only species of *Syrmaticus* that lacks iridescent colouration in males, and it exhibits less sexual dimorphism in plumage colouration than the others.

#### **Reproductive biology**

##### *Breeding season and nesting*

Delacour (1977) stated that the natural breeding season is from the end of March to the beginning of July. Yamashina (1976) reported that the breeding season begins in April or May in the colder areas, and about March in more southerly regions. Under captive conditions, the peak of the laying period appears to be from late April to mid-May, with the eggs being laid in late afternoon or evening. Nests are made on the ground, usually beneath a fallen tree, and clutches consist of from seven to 13 eggs.



**Fig. 29.** Postures of male copper pheasant, including wing-flapping (A), normal posture (B), and facial engorgement (C). After Yamashina (1976) and photographs by the author.

In captivity females lay from their first year until they are at least seven years old, although peak numbers of eggs come from birds between three and six years old, when from 21 to 31 eggs per year are typical. First-year birds lay only an average of 10 eggs per season, while birds two or seven years old average less than 20.

#### *Incubation and brooding*

Incubation in this species requires 24–25 days, and the role of the male in defending the nest, if any, is unknown.

#### *Growth and development of the young*

The artificial rearing of the young is no different from that of any of the other typical pheasants, according to Yamashina, although he noted that they are highly vulnerable to disease if allowed contact with other poultry. Adult plumage and sexual maturity is attained during the first year.

#### **Evolutionary history and relationships**

This species is perhaps the least typical of the *Syrnaticus* species, and has perhaps been isolated from

the others for the longest period. Some authorities (Yamashina 1976) consider it to be within the genus *Phasianus*, and it has been hybridized with the green pheasant in captivity (Hachisuka 1953) as well as perhaps also in the wild (Yamashina 1976; Delacour 1977), these hybrids reportedly being infertile. However, hybrids between the copper pheasant and Reeves' pheasant are said to be fertile in the case of males.

#### **Status and conservation outlook**

Nearly a million of these birds are legally killed each year in Japan, and there seems to be no major concern for the future of this bird. Since 1976 it has been illegal to kill female copper pheasants, since habitat destruction and greater hunting pressures seem to have been causing population decreases in recent years. As of 1976 there were 2706 sanctuaries in Japan, covering a total area of some 2.6 million ha, which are mainly in the woodlands of mountainous districts, so certainly many of these areas are protecting this species directly (Yamashina 1976).



# 11 · Genus *Phasianus* Linné 1758

The true pheasants are medium-sized, temperate, open-country pheasants in which sexual dimorphism is well developed in males, and in which the tail is greatly elongated and strongly barred; the rectrices have fringed edges and erectile ear-tufts are present. The orbital wattles are red, moderate in size, and of smooth texture, with scattered black plumules present. Males have disintegrated rump feathers forming a hair-like texture. The tail is highly graduated, flat to slightly compressed, and of 18 rectrices that are only slightly spread during display. The tail moult is phasianine (centripetal). The wing is rounded, with the tenth primary much longer than the first, and about equal to the third. The tarsus is longer than the middle toe and claw, and is spurred in males. Males are extensively iridescent over most of their plumage excepting the abdomen, wing and tail; the head is strongly metallic-coloured. Females are rather uniformly brownish and lack white spots or shaft-streaks. Two species are recognized.

## KEY TO SPECIES (AND SUBSPECIES OF MALES) OF *PHASIANUS*<sup>1</sup>

- A. Plumage mostly dull brown (females).
  - B. Feathers of the mantle spotted with black; underparts distinctly mottled: green pheasant.
  - BB. Feathers of the mantle spotted with brown; underparts not mottled: common pheasant.
- AA. Plumage mostly iridescent (males).
  - B. Underparts entirely greenish: green pheasant.
  - C. Smaller (wing 215–225 mm) and generally lighter throughout: northern green pheasant (*robustipes*).
  - CC. Larger (wing 225–245 mm) and generally darker throughout.
    - D. Back and rump mostly greenish: southern green pheasant (*versicolor*).
    - DD. Back and rump greyer and bluer: Pacific green pheasant (*tanensis*).
  - BB. Underparts always with some coppery red: common pheasant.
    - C. Lower back, rump and upper tail-coverts maroon or rufous, sometimes glossed with green; black tail-bars usually narrow.
    - D. Without a white neck-ring, or only traces present.

E. Wing-coverts reddish or sandy brown; more purplish throughout (black-necked pheasant group).

F. Sides and mantle purplish orange; wing-coverts darker brown.

G. Middle of breast and sides of belly dark purplish green.

H. General colour more coppery red: southern Caucasian pheasant (*colchicus*).

HH. General colour paler, more golden orange: northern Caucasian pheasant (*septentrionalis*).

GG. Middle of breast purplish red-bronze: Talich Caucasian pheasant (*talischensis*).

FF. Sides and mantle golden orange; wing-coverts sandy buff: Persian pheasant (*persicus*).

EE. Wing-coverts white or nearly so; more reddish throughout (white-winged pheasant group).

F. Middle of breast and sides of belly dark green.

G. Flanks narrowly tipped with black; black tail-bars broader: Yarkand pheasant (*shawii*).

GG. Flanks broadly tipped with black; black tail-bars narrower.

H. Chest and breast lighter: Khivan pheasant (*chrysomelas*).

HH. Chest and breast darker: Bianchi's pheasant (*bianchii*).

FF. Middle of breast and sides of belly coppery red.

G. Chest and upper breast feathers with narrow black edges; centre of belly dark brownish: Persian pheasant (*persicus*) (of previous group).

GG. Only the sides of chest and breast edged with black; centre of belly light chestnut.

H. White collar incomplete and very narrow.

I. Flanks spotted with black and purplish blue: Zerafshan pheasant (*zerafschanicus*).

II. Flanks spotted with blackish green: Zarudny's pheasant (*zarudnyi*).

HH. Collar absent or present only as white spots: Prince of Wales' pheasant (*principalis*).

DD. With a wide white neck-ring (Kirghiz pheasant group).

E. Chest glossed with green; narrower white neck-ring: Kirghiz pheasant (*mongolicus*).

<sup>1</sup> Many of these forms represent questionable subspecies, and thus any key is subject to considerable subjectivity.

- EE. Chest glossed with purple; wider white neck-ring: Syr Daria pheasant (*turcestanicus*).
- CC. General colour of the lower back, rump and upper tail-coverts greenish to slate or olive-green.
- D. Lower back and rump mostly olive-green; tail less heavily barred; no white neck-ring: olive-rumped pheasant (*tarimensis*).
- DD. Lower back and rump greyish to bluish green; tail more heavily barred; usually with white neck-ring (grey-rumped pheasant group).
- E. No white neck-ring, or the ring about one-third incomplete.
- F. Dark green of the neck extending to the middle of the chest.
- G. Flanks golden buff; mantle bright sandy red: Zaidan pheasant (*vlangalii*).
- GG. Flanks coppery maroon.
- H. Mantle bright chestnut; sides more purplish: Stone's pheasant (*elegans*).
- HH. Mantle and sides more golden: Rothschild's pheasant (*rothschildi*).
- FF. Dark green of the neck bordered by yellow or coppery red of the chest.
- G. Chest and breast feathers broadly margined with black; flanks buffy.
- H. With a narrow neck-ring and sometimes white 'eyebrows'.
- I. White eyebrows absent: Sohokoto pheasant (*sohokotensis*).
- II. Eyebrows present.
- J. Eyebrows dingy, neck-ring more complete: Shansi pheasant (*kiang-suensis*).
- JJ. Eyebrows white, neck-ring less complete: Alashan pheasant (*alashanicus*).
- HH. No white eyebrows or neck-ring: Kweichow pheasant (*decollatus*).
- GG. Chest and breast feathers narrowly margined with black; flanks darker: Strauch's pheasant (*strauchi*).
- EE. White neck-ring present and complete or nearly so.
- F. Neck-ring narrow and nearly or wholly interrupted in front.
- G. Chest and breast feathers margined with blackish green; general colour very pale.
- H. Scapulars margined with sandy brown.
- I. Mantle pale golden, with white feather centres: Satchu pheasant (*satscheuensis*).
- II. Mantle bright golden; no white feather centres: Gobi pheasant (*edzianensis*).
- HH. Scapulars margined with red maroon: Taiwan pheasant (*formosanus*).
- GG. Chest and breast feathers not margined, or only barely margined with blackish green.

- H. Mantle light golden; scapulars chestnut: Chinese pheasant (*torquatus*).
- HH. Mantle darker golden; scapulars maroon: Tonkinese pheasant (*takatukasae*).

FF. Neck-ring complete and broad, even in front.

G. Black patch under eye with a white spot: Manchurian pheasant (*pallasi*).

GG. Black patch under eye, usually without a white spot.

H. General colour very pale: Kobdo pheasant (*hagenbecki*).

HH. General colour very dark: Korean pheasant (*karpowi*).

## COMMON PHEASANT

*Phasianus colchicus* Linné 1758

Other vernacular names: black-necked pheasant, Mongolian pheasant, ring-necked pheasant; faisane de Colchide (French); Edelfasan, Jädfasan (German).

### *Distribution of species*

Delta of the Volga, northern Caucasus, and Transcaucasia, eastward through northern Iran to Afghan Turkestan, and from Transcaspia and Russian Turkestan eastward through Chinese Turkestan and Mongolia to the Amur Valley and Ussuriland (but locally distributed only in most of these regions), southward through Manchuria, Korea, and China including Taiwan to northern Burma and Tonkin. Sedentary, but some migratory movements have been reported in *pallasi*. Introduced in Europe, North America, Hawaii, Japan, Australia, and New Zealand. Occurs in open country, in park or farmland, scrubby wastes, along the edges of woods, grassy steppes, hills and the lower mountain slopes with more or less sparse oaks, chestnuts, or pines, and the oases of the desert and along its rivers and lakes in reed beds or riverside thickets of tamarisks, poplars, wild olives, or of other trees and shrubs; also swamps, edges of rice fields, and in open forest in the mountains and their valleys in western China, where it ascends to 13 000 ft (Vaurie 1965). See maps 15 and 16.

*Distribution of subspecies* (after Vaurie, 1965, and Wayre, 1969, excluding introductions)

1 *The nominate colchicus group* (black-necked pheasants). *Phasianus colchicus colchicus* L.: southern Caucasian pheasant. Transcaucasia from Abkhazia east to Georgia (north to Kakhetia and Korelia) to the region of Telavi, north-east Azerbaijan in the regions between Zakataly and Ismailly and between





**Map 15.** Distribution of Alashan (Al), Bianchi's (B), Chinese (C), Gobi (G), Khivan (Ka), Kirghiz (Ki), Kobdo (Ko), Korean (K), Kweichow (Kw), Manchurian (M), northern Caucasian (N), Persian (Pe), Prince of Wales (PW), Rothschild's (R), Satchu (Sa), Shansi (Sh), Sohokhoto (Soh), southern Caucasian (So), Stone's (St), Strauch's (S), Sungpan (Su), Syr Daria (Sy), Taiwan (T), Talish Caucasian (Tal), Tarim (Ta), Tonkin (To), Yarkand (Y), Zaidan (Zi), Zarudny's (Z), and Zerafshan (Ze) races of common pheasant. The introduced range in Europe (cross-hatched) is of birds of varied racial origins.

Kuba and Khachmas and southern Armenia, possibly also in north-west Iran. The birds found in Turkey and extreme south-east Europe are identical with those of Transcaucasia and may be indigenous, or may have been introduced. Introduced widely in Europe and elsewhere; birds from Turkey, Bulgaria, and Thrace may be either introduced or native.

*Phasianus colchicus septentrionalis* Lorenz: northern Caucasian pheasant. Northern Caucasus from Dagestan north to the delta of the Volga; western limits unknown.

*Phasianus colchicus talischensis* Lorenz: Talish Caucasian pheasant. South-east Transcaucasia (in Talych north to the lower Kura River), eastwards

along the southern Caspian districts of Iran to the Babol Sar and Sari in eastern Mazandaran, where it intergrades with *persicus*. Intergrades with nominate *colchicus* in the west.

*Phasianus colchicus persicus* Severtzov: Persian pheasant. South-west Transcaspiian region in the valleys of the Atrek and Gurgun rivers and their tributaries, south-east coast of the Caspian Sea, west to Ashurada.

2 *The principalis-chrysomelis group (white-winged pheasants).* *Phasianus colchicus principalis* P. L. Sclater: Prince of Wales' pheasant. Southern Russian Turkestan and northern Afghanistan, chiefly in the



**Map 16.** Introduced distributions of common pheasant in North America (denser distributions indicated by darker shading), Australia, and New Zealand. See text for Hawaiian and other minor introduced populations.



Tejend Valley, west to fifty miles east of Askhabad, north to the Kara Kum desert, south to the Murghab valley and the oases of Merv, Yelotan, and Panj-deh.

*Phasianus colchicus zarudnyi* Buturlin: Zarudny's pheasant. Valleys of the middle Amu Daria from about Kerki down to Darganata.

*Phasianus colchicus bianchii* Buturlin: Bianchi's pheasant. Upper Amu Daria Valley between the Hissar, Alai, Pamir, and Hindukush mountains in the Bukhara Province.

*Phasianus colchicus chrysomelas* Severtzov: Khi-van pheasant. Delta of the Amu Daria, along the southern shore of the Aral Sea, west to the Ust-wits plateau and south to the Kara Kum desert.

*Phasianus colchicus zerafschanicus* Tarnovski: Zerafshan pheasant. Zerafshan Valley in Bukhara, north to the Zerafshan-Syr Daria Divide, south to the Hissar mountains.

*Phasianus colchicus shawi* Elliot: Yarkand pheasant. Sinkiang in the western part of the Tarim basin from the Khotan Darya west to Yarkand and Kashgar and east from here to Maralbashi, the lower River Aqsu and the upper River Tarim. Considered part of Tarim group by Vaurie (1965), and intergrades locally with *tarimensis*.

3 *The mongolicus group (Kirghiz pheasants)*. *Phasianus colchicus turcestanicus* Lorenz: Syr Daria pheasant. Valley of the Syr Daria from the delta and nearby coastal islands of the east coast of the Aral Sea, eastward to western part of Ferghana Valley and on slopes of neighbouring mountains to the north and east. Includes *bergii* Zarudny.

*Phasianus colchicus mongolicus* J. F. Brandt: Kirghiz pheasant. A very large range in north-east Russian Turkestan, north to lat. 48° N, depressions of Lakes Issyk-kul, Balkash, Ala-kul, Zaisan, eastward to tributaries of the River Illi and Dzungaria, from Ebi Nor to Guchen in Chinese Turkestan. Does not occur in Mongolia.

4 *The Tarim pheasant*. *Phasianus colchicus tarimensis* Pleske: Tarim pheasant. Sinkiang in the eastern and southern parts of the Tarim basin along the River Tarim (east of range of *shawi*) and regions of Qara Shahr and Bagrach Kol, east to Lop Nor and westward along the course of the Cherchen Darya to the Niya Darya. Intergrades to the west with *shawi*, which is sometimes considered part of this group.

5 *The torquatus group (grey-rumped pheasants)*. *Phasianus colchicus hagenbecki* Rothschild: Kobdo ring-necked pheasant. Isolated in western Outer Mongolia from the northern foothills of the Altai, north to Lake Khara Usu and the basin of the Khobdo River to Lake Achitu Nor.

*Phasianus colchicus pallasi* Rothschild: Manchurian ring-necked pheasant. South-east Siberia from the upper Amur and Ussuriland south of lat. 44° N to northern Chihli, central Manchuria and northern Korea above lat. 40° N, intergrading with *karpowi*.

*Phasianus colchicus karpowi* Buturlin: Korean ring-necked pheasant. Southern Manchuria, south to northern Hopeh and most of Korea, also islands of Tsushima and Quelpart. Intergrades with *pallasi* and *kiangsuensis*; the population is unstable.

*Phasianus colchicus kiangsuensis* Buturlin: Shansi pheasant, China, north of the Hwang-ho; western and southern Chihli, northern Shansi and Shensi and adjacent parts of south-east Mongolia.

*Phasianus colchicus alaschanicus* Alphéraky and Bianchi: Alashan pheasant. Isolated in oases near the western foothills of Ala-shan.

*Phasianus colchicus edzinensis* Sushkin: Gobi ring-necked pheasant. Oases of the central Gobi in the valley of the Edzin-gol and near Sokho-nor.

*Phasianus colchicus satscheuensis* Pleske: Satchu ring-necked pheasant. Isolated in the extreme west of Kansu, north of Nan Shan (Tunhwang) in the basin of the lower Tunhwang-ho and that of lower Shuleh-ho, east to at least Ansi.

*Phasianus colchicus vlangalii* Przevalski: Zaidan pheasant. Northern Tsinghai, where it is restricted to the marshes of the Zaidan Depression.

*Phasianus colchicus strauchi* Przevalski: Strauch's pheasant. Southern Shensi (Tsinling Range), westward across southern Kansu to Tsinghai, north to central Kansu to at least Wuwei (formerly Liangchow). It intergrades with *kiangsuensis*.

*Phasianus colchicus sohokhotensis* Buturlin: Sohokhoto pheasant. Isolated in the Sohokhoto Oasis in southern Ala-Shan.

*Phasianus colchicus suehschanensis* Bianchi: Sungpan pheasant. North-west Szechwan from the Min Shan Range and region of Sungpan, south to Kwanhsien, south of which it intergrades with *elegans*.

*Phasianus colchicus elegans* Elliot: Stone's pheasant. Western Szechwan (Sikang) west to long. 99° E, south to the Likiang Range in north-west Yunnan and north-east Burma.

*Phasianus colchicus rothschildi* La Touche: Rothschild's pheasant. Mountains of eastern Yunnan and adjacent Tonkin.

*Phasianus colchicus decollatus* Swinhoe: Kweichow pheasant. Central China from western Hupeh west to the Red Basin of Szechwan, south to north-eastern Yunnan and Kweichow. It intergrades in the east with *torquatus*.

*Phasianus colchicus takatsukasae* Delacour:

Tonkinese ring-necked pheasant. South-east Tonkin and adjoining part of China (Kwangsi Province).

*Phasianus colchicus torquatus* Gmelin: Chinese ring-necked pheasant. Eastern China from Shantung, south to the borders of northern Tonkin, where it intergrades with *rothschildi* and *takatsukasae*.

*Phasianus colchicus formosanus* Elliot: Taiwan ring-necked pheasant. Island of Taiwan (Formosa) at low and moderate altitudes.

### Introduced populations

Introduced populations representing numerous subspecies (and *P. versicolor* in some cases) exist in Europe from the British Isles, southern Norway, and southern Sweden to Spain, France, Corsica, Italy, Germany, Hungary, Yugoslavia, Greece, and Bulgaria. In Canada, the species occurs in extreme southern British Columbia, southern parts of Alberta, Saskatchewan, Manitoba, and Quebec, plus New Brunswick, Nova Scotia, and locally on Newfoundland. Established populations in the United States occur from Washington's Canadian border south to California and on into north-east Baja California, and in the east from Maine through New York, Pennsylvania, New Jersey, Maryland, Indiana, Missouri, Oklahoma, and south to northern Texas, New Mexico, and south-east Arizona. On the Hawaiian Islands the birds have been established on Kauai, Molokai, Lanai, Maui, and Hawaii. In New Zealand they occur over much of the North Island and locally on the South Island. In Japan they are established on Hokkaido and possibly elsewhere. They are local in central Chile (Bay of Coquimbo), on St Helena, and on Australia's King and Rotnest islands, plus Tasmania. They are possibly also established on mainland South Australia and on Flinders Island, as well as on Eleuthera, Bahama Islands. They have also been introduced but later extirpated in several areas, and have been unsuccessfully introduced in many other areas (Long 1981).

### Measurements

(see also facing table)

Weight data from the native range in Asia are rather limited, but Cheng (1963) noted that fifteen males of *karpowi* averaged 1296 g (range 1007–3090), and seven females averaged 798 g (range 560–1120), while seven males of *strauchi* averaged 1062 g (range 980–1204), and seven females averaged 835 g (range 760–920). Dementiev and Gladkov (1967) noted that a January sample of male *colchicus* (number unstated) averaged 1150 g and females averaged 850 g, while four males of *bianchi* averaged

1106.5 g (range 956–1300) and two females were 710 and 850 g. They also noted that four males of *turcesanicus* averaged 1353 g (range 1170–1477) and five females 838 g (range 740–1018), while fourteen males of *pallasi* averaged 1174.4 g (range 1090–1330) and nine females averaged 1081.5 g (range 970–1220). An unstated number of males of *mongolicus* averaged 1100 g (maximum 1400), and females averaged 800 g (maximum 1000 g). Bohl (1964) stated that males of *karpowi* range from about 1245–1360 g and females from about 906–1245 g.

Trautman (1982) has tabulated a great deal of weight data on the North American population found in South Dakota (birds of varying racial origins), and reported a yearly average adult weight of 44.5 oz (1263 g) for males, and a similar yearly average of 32.3 oz (916.5 g) for females, with sample sizes of 13 124 and 2071, respectively. Additional weight data on nominate *colchicus* is summarized in Cramp and Simmons (1980). Eggs average about 45 × 36 mm, and the estimated fresh weight is 32.2 g.

### Description (after Cramp and Simmons 1980)

#### *Male (of colchicus)*

Feathered parts of head black, glossed bronze on crown, purple at sides of neck and throat, dark green elsewhere. Mantle copper-red glossed violet in some lights; feather-tips with narrow black edges and broad black dot at central tip. Scapulars and back copper-red with glossy violet tips and U-shaped pale buff and black marks, the latter with blue-green gloss. Feathers of rump dense; fringes hair-like, copper-red with green or violet gloss; concealed bases vermiculated cinnamon and sepia. Upper tail-coverts buff-brown with sepia vermiculations, tips bordered chestnut. Chest, breast, and flanks deep copper-orange, glossed strongly purple-pink in some lights, tips of feathers margined purple-blue; on chest, margins narrow and slightly W-shaped; on flanks, bold and widely spaced with little purple-blue on lower flank. Belly and vent black, glossed blue-green on upper and lateral belly, tinged buff-brown on vent; under tail-coverts rufous-chestnut with some black marks. Centres and tips of 1–2 central pairs of tail feathers buff-brown with narrow, well-spaced black bars, loose-webbed sides uniform copper-red with purple-pink gloss; other tail feathers similar, but inner edges and tips vermiculated grey-buff and dull black, outer feathers wholly vermiculated. Upper wing-coverts deep buff, inner, median, and greater widely margined rufous-purple, marginal and outer with partly concealed dull black and pale pink-buff marks. Primaries, primary coverts, and alula quills dark sepia with short, curved, and partly mottled pale buff bars; latter vague or absent on



	Males			Females			References
	Wing (mm)	Tail (mm)	Weight (g)	Wing (mm)	Tail (mm)	Weight (g)	
<i>colchicus</i>	238–258	425–536	ave. 1150	210–220	290–310	ave. 850	Delacour 1977
<i>septentrionalis</i>	250–276	395–406 <sup>1</sup>	—	228–205	225–280 <sup>1</sup>	—	Dementiev and Gladkov 1967
<i>principalis</i>	235–253	390–510	—	208–225	—	—	Dementiev and Gladkov 1967
<i>zarudnyi</i>	227–244	—	—	213–224	—	—	Vaurie 1965
<i>bianchi</i>	240–260	—	956–1300	219	—	710–850	Dementiev and Gladkov 1967
<i>chrysomelas</i>	235–250	483 <sup>1</sup>	—	228	315 <sup>1</sup>	—	Dementiev and Gladkov, 1967
<i>shawii</i>	233–250	370–515	—	211 <sup>1</sup>	284 <sup>1</sup>	—	Vaurie 1965
<i>turcestanicus</i>	240–263	—	1170–1477	220–240	266–285 <sup>1</sup>	740–1018	Dementiev and Gladkov 1967
<i>mongolicus</i>	248–267	510–580	ave 1100	215 <sup>1</sup>	312 <sup>1</sup>	ave. 800	Delacour 1977
<i>strauchi</i>	225–238	378–595	ave. 1062	196–215	197–275	ave. 835	Dementiev and Gladkov 1967
<i>tarimensis</i>	240	465	1031	209–222 <sup>1</sup>	241–260 <sup>1</sup>	—	Cheng 1963
<i>pallasi</i>	235–245	435–485	1264–1650	210–211	225–285	880–900	Cheng <i>et al.</i> , 1978
<i>karpowi</i>	217–235	424–570	1000–1312	194–208	220–290	545–875	Cheng <i>et al.</i> , 1978
<i>kiangsuensis</i>	220–235	438–675	1000–1100	199–215	238–279	700–1000	Cheng <i>et al.</i> , 1978
<i>suehschanensis</i>	217–232	375–460	770–1000	—	—	—	Cheng <i>et al.</i> , 1978
<i>elegans</i>	205–230	410–465	820–1250	184–200	235–240	750–800	Cheng <i>et al.</i> , 1978
<i>decollatus</i>	230–242	490–576	1135–1990	206	247	625	Cheng <i>et al.</i> , 1978
<i>torquatus</i>	240–254	425–560	—	208 <sup>1</sup>	266 <sup>1</sup>	—	Dementiev and Gladkov 1967
All races	205–276	370–675	770–1990	184–240	220–315	545–1018	

<sup>1</sup> personal observations.

outer webs and tips of primaries, and tending to form streaks at tips of coverts; secondaries similar, but bars more irregular and outer edges buff-brown with fine black specks. Underwing and axillaries pale grey mottled pale buff; smaller coverts buff or cinnamon, mottled black. Iris yellow-brown, reddish brown to orange-yellow, bill horn-yellow to greenish yellow, legs and feet horn grey, facial skin vermilion.

#### Female

Forehead and crown black with broad buff bars and edges; broad streak over eye, nape, and sides of chin and throat pink-buff with faint dark specks. Ear-

coverts buff-brown, remaining sides of head and neck pale buff, faintly speckled or barred black; chin and throat pale buff. Feathers of mantle chestnut with black subterminal U-marks and broad pearly-pink fringes, mottled dusky at tip on lower mantle; chest and sides of breast similar, but bases paler cinnamon or buff. Black on feather bases of scapulars, back, and rump projects in point towards bright brown tip; broad fringes pale buff with olive-grey borders and mottling. Upper tail-coverts like back, but longer coverts barred pale buff. Flanks pink-buff with black V-marks and pale buff fringes finely mottled dusky at tips. Breast, belly, and vent pale buff faintly specked brown. Under tail-coverts irregularly

barred pink-buff, sepia, and buff. Tail buff-brown, slightly darker rufous-brown towards shafts of central pair; feathers with dusky specks at sides and with narrow, well-spaced pale buff bars, latter broadly bordered with black near shafts, narrower at sides; bars on outer feathers closer and narrower. Primaries, primary coverts, and alula quills sepia with pale buff bars (wider, straighter, and more distinct in male), tips, except outermost, margined pale buff; secondaries similar, but sepia bars partly mottled buff, tips fringed pale buff. Secondary upper wing-coverts pale buff with black heart-shaped subterminal dots and black dots to bases, broad fringes grey-buff. Tertiaries black mottled brown, barred and edged pale buff. Under wing-coverts and axillaries pale grey-brown indistinctly barred pale buff. Iris yellow brown to hazel, bill horn brown, legs and feet greyish brown.

#### *Immature*

Like the female, but duller, with a shorter tail and less definite plumage patterning. Young males attain their adult plumage by about 4½ months of age.

#### **Identification**

##### *In the field* (21–35 in.)

This most widespread species of pheasant is quite variable in plumage, but always has a purplish head and neck, with or without a white neck-ring, a maroon-coloured breast tending toward orange on the flanks, and an elongated and barred tail. In areas where confusion with the green pheasant is possible, the brownish rather than greenish tones of the flanks, breast, and mantle are the best distinguishing characteristics. Melanistic mutants especially resemble green pheasants, but are somewhat larger, and have longer (over 12 in.) tails.

Calls of the male are highly varied, but the male's crowing call is a loud, hoarse, and sudden *Ko-or OK*, or *korrk-kok* or *kok-ok-ok*, with the last syllable very staccato. Wing-whirring also is used by males during spring. Females are generally yellowish buff in colour, with a chestnut wash on the upperparts, especially the neck. The tail is long and banded with black and chestnut barring.

##### *In the hand*

This species is likely to be confused only with the green pheasant. Males of that species have a shorter tail (to 425 mm) and are much more greenish throughout, especially on the upperparts. Females are less strongly marked with black dorsally, and the underparts are less distinctly mottled and blocked

with darker colouration, and normally are pale buff in this area, with only a few dark spots.

#### **Geographic variation**

Geographic variation in this species is among the greatest of any species in the pheasant group, at least in males, and varies from clinal to quite abrupt, the latter most typical of isolated populations. In general, the clines among males exhibit an increase in colour saturation, a reduction of the white collar, and a decrease in size from north to south. Females are essentially the same throughout, although they tend to be darker and more heavily marked in the easternmost areas (the *torquatus* group) (Vaurie 1965).

Studies by Vaurie and Delacour indicate that five groups of subspecies can be recognized, and their taxonomy is followed here. The first, or nominate *colchicus* group, consists of the westernmost forms or 'black-necked' pheasants. Males of this group are the most purplish, have brown or buffy upper wing-coverts, and lack white collars or have only faint traces of one. The second group, the 'white-winged' pheasants or *principalis-chrysomelas* assemblage, replaces *colchicus* farther east, and males of this group are more reddish and less purplish dorsally, and have white or whitish wing-coverts. Some of its included subspecies have incomplete and irregular white collars. The third array, the 'Kirghiz' or *mongolicus* group, that is found in Turkestan (not Mongolia) also have white on the wings but are more coppery with strong bronzy green iridescence, and usually have distinct but incomplete white collars. The Tarim Basin group consists of one (Delacour) or two (Vaurie) subspecies which are transitional between these first three groups and the more eastern forms. The Tarim pheasant (*tarimensis*) lacks a white neck-ring and has an olive-coloured rump, but has light sandy-brown wing-coverts. The Yarkand pheasant (*shawii*), which is considered by Delacour to be part of the preceding group, also lacks a neck-ring, but is generally more white-winged and is distinctly golden yellow on the upperparts. The final group, the grey-rumped pheasants or *torquatus* complex, consists of a large number of subspecies that all have the lower back and rump light grey (tinged and marked with blue, green or buff), grey wing-coverts, a mantle and flanks that are always lighter and more yellow than the scapulars and breast, and a buffy olive tail that is heavily barred with black and fringed with pinkish purple. Some of the races have white 'eyebrows', and some also have a white collar, but these traits are quite variable (Delacour 1977; Vaurie 1965).



## Ecology

### *Habitats and population densities*

Habitats of the many subspecies vary greatly, but in China consist of three general environments, the overgrown edges of rivers, hilly areas close to large cultivated fields having small bamboo groves and low pine thickets, and flat and level lands cultivated with rice, wheat, or rape (*Brassica*) (Cheng 1963). In the USSR the primary biotype similarly consists of shrubbery and thickets of bulrushes in river valleys, cultivated terrain, and to some extent occurs in brush-covered river valleys of mountains, mostly to elevations of between 1500 and 2600 m and rarely to 3400 m (Dementiev and Gladkov 1967). Desert-adapted subspecies sometimes occur in quite arid areas of alkaline soils, but here the birds are largely limited to riverine areas or other areas of available fresh water. In the western Palearctic the birds occur from lowlands and broad river valleys to foothills and dry uplands, in areas without deep winter snows or severe cold, becoming limited in mountains to narrow wooded valleys and gorges, and infrequently occurring above 700 m (Cramp and Simmons 1980). Similar habitats are used in North America, but there the birds are largely associated with cultivated lands (grains, soybeans, alfalfa, etc.) with nearby grassy and weedy cover, or shrubby areas such as hedges, ditches, marshy edges, woodland borders, brushy groves, and the like. They become increasingly limited to irrigated areas in the western and south-western parts of the North American range. The birds do not thrive in areas of heavy snowfall nor in areas of either extreme winter cold or intense summer heat, and are especially associated with the 'corn belt' and associated calcium-rich soils of central North America (Edminster 1954). In Hawaii the birds are found from sea level to 11 000 ft, in areas where the rainfall varies from under 10 to more than 300 in. annually, in all types of soil, topographic and climatic conditions, and in cultivated areas as well as forested, grassland, desert, or other waste areas (Schwartz and Schwartz 1951).

Population densities are better known in areas of the species introduced range than its indigenous range. For example, in some areas of New Zealand average population densities of from 2.3 to 13.8 birds per km<sup>2</sup> have been reported (Westerskov 1963). In Hawaii, the population in the mid-1940s averaged about 19 birds per square mile (11.8 per km<sup>2</sup>) for the area as a whole, but varied from less than ten to nearly 100 birds per square mile in some localities (Schwartz and Schwartz 1951). Similarly great variations in density have been reported in North America, even in such small areas as, for example, Pelee Island, Ontario (with a land area of 10 000 acres)

where an introduced pheasant population rose from 36 birds in 1927 to about five birds per acre by 1934 (Stokes 1954). A similar enormous but temporary buildup of population density (to 3.87 birds per acre) occurred on the 397-acre Protection Island off the coast of Washington, within five years after pheasants were introduced there (Einarsen 1945). Edminster (1954) judged that in North America, first-class pheasant range should support about one adult per 3–4 acres (1.2–1.6 ha) in spring, while poor range may have an adult per 15–20 acres (6.6–8 ha) in spring. Estimated autumn (adult and young) densities in first-class range were a bird per acre, and 5–10 acres per bird in poor range. Studies in south-central Nebraska over a period of a decade resulted in estimates of adult (spring) densities of about three to eight birds per 100 acres (7.4–19.8 per km<sup>2</sup>) in three different study areas of good pheasant habitats (Baxter and Wolfe 1973), and these densities would appear to be fairly representative of many midwestern areas. Spring estimates of as high as about 80 females per square mile (50 per km<sup>2</sup>) were reported in Iowa during the very high populations of the early 1940s, but more typical densities for the same area were in the range of no more than 40 females per square mile (25 per km<sup>2</sup>) (Kozicky and Hendrickson 1951). Twenty or more broods produced per km<sup>2</sup> also occur in some parts of the USSR (Dementiev and Gladkov 1967).

### *Competitors and predators*

Some of the major predators of ring-necked pheasants in North America were mentioned in Chapter 5; these consist of a considerable array of raptors and wild mammals, especially foxes. Wagner, Besadny, and Kabat (1965) reviewed the available information on predators and their effects in North America, mentioning 12 mammals, 9 birds, and 2 reptiles as known predators on adults or young, and 14 mammals, 3 birds and 2 snakes as known nest predators. Bohl (1964) reviewed the known and probable predators of pheasants in Korea, whilst Dementiev and Gladkov (1967) mentioned a considerable number of known or presumptive enemies of pheasants in the USSR. Cheng (1963) said that in China the species' most serious enemy is the civet cat, although wolves, foxes, eagles, owls, and various other predators also may be of significance. Competitors doubtless vary greatly over the enormous native and introduced range of his species, and cannot be easily summarized.

## General biology

### *Food and foraging behaviour*

A considerable amount of information on pheasant foods was provided in Chapter 5, from which it is

apparent that very great local and seasonal differences exist in the foods of this species, which is relatively omnivorous and opportunistic, tending to consume large and energy-rich foods that are easily available, such as cultivated grains, mast, fruits, etc. The relative abundance of insects and other animal life in the diet also seems to be highly variable, except that in young birds (up to about four months old) it is invariably higher than in adults. Thus, Ferrel, Twining, and Herkenbaum (1949) reported that 20 birds up to three weeks old averaged 82.9 per cent animal foods, 23 from four to six weeks of age averaged 47.2 per cent, 21 from seven to nine weeks averaged 55.1 per cent, 31 from 10 to 12 weeks averaged 12.5 per cent, and 34 from 13 to 16 weeks averaged only 1.8 per cent.

#### *Movements or migrations*

Significant movements in this species seem to be limited to populations in northern areas which are forced out of breeding areas during winter. Cramp and Simmons (1980) have summarized the data for the western Palearctic, where in Sweden, Norway, Denmark, and Britain movements greater than a few kilometres during a bird's lifetime are unusual, and almost none move more than 10 km. However, exceptional cases of movements as great as 40 km have been noted in Sweden, and in Finland one adult male was found to have moved 210 km in 13 months. In North America, various studies have similarly indicated a rather high level of sedentary behaviour (e.g. Gates and Hale 1974, as summarized in Chapter 5). However, in the Amur Basin of the USSR there have been several massive migrations of pheasants, mainly adult males, from China during periodic severe winters (Baranchev 1965).

#### *Daily activities and sociality*

Like the more tropical species of pheasant, this species also exhibits a high level of diurnal periodicity in its activities. Calling activity by males may begin before sunrise, and at that time the birds typically leave their roosting sites to forage, which may occupy two or three hours. Thereafter, the birds typically move to a source of water, particularly in the dry regions. The birds may remain at such sites for only a short time, after which they are likely to spend the warmest part of the day resting in shady areas, where preening, dust-bathing, and sleeping may occur. Towards evening the birds forage again, and frequently also visit sources of grit at such times. Foraging may continue until it is almost dark, when the birds proceed to their roosts. These roost sites may sometimes be in trees, but much more frequently are in dense brushy areas, reedbeds, or other areas providing relatively heavy cover.

Sociality patterns probably vary greatly with population density and levels of disturbance, if not other factors, but at least in North America some patterns have emerged. The study of Collias and Taber (1951) may be representative. They found that, during winter, the birds formed temporary flocks in which individuals moved about and fed together as a more or less coherent unit with a shifting membership. Males and females sometimes fed together, but also often formed unisexual groupings. Roosting groups during winter varied from two to two dozen birds or more, with larger groups typical of very cold weather. The locations of these roosts varied somewhat, although there were favourite roosting sites. Gradually these groupings changed to harems of hens, with each harem dominated by a single male, as the breeding season progressed. Shifting of male groups from the period in which they occurred in pairs, trios or larger groupings to the period of male dispersal and territorial establishment was associated with active increase in testis size, the start of male display toward females, and the onset of intimidation behaviour (fighting or threat display) among the females. Both males and females were found to exhibit dominance hierarchies, which seemed to be related to age and perhaps also to weight. All males were found to dominate all females, and males that began to crow and display early in the season generally dominated the males that began later.

### **Social behaviour**

#### *Mating system and territoriality*

A harem system of mating is well known for this species and, as just mentioned, male success in attracting varied numbers of females seems to be related to relative male-to-male and male-to-female dominance characteristics. Although supposedly 'territorial', there is little evidence for well-defined male territories in this species, as reviewed in Chapter 5. This may account for the great variations in the sizes of crowing territories as judged by various observers, ranging from as small as 3 or 4 acres to as large as 25 to 75 acres (Edminster 1954). Kozłowa (1947) avoiding calling these areas territories, and instead referred to them as 'cruising routes', since she never saw a male expel another from them. She believed that the route was not over 400–500 m in length, and was regularly traced and retraced by males for both foraging and sexual purposes. Taber (1949) agreed with the idea of males having territories but thought their boundaries were highly plastic, and were affected by population density as well as by such local environment features as relative cover and topography.



### *Voice and display*

Probably the most important and certainly the most conspicuous vocal signal of male pheasants is their crowing call. This call is loud, sudden, and harsh, typically consisting of two or three syllables, and sounding like *korrk-kok*, *KO-or OK*, *ko-koro*, or various other transcriptions. It may carry up to a mile or so under favourable situations, and usually followed by wing-whirring. As many as twelve other adult calls have been distinguished in this species (Heinz and Gysel 1970), none of which seems to be so clearly associated with sexual display with the possible exception of hissing, which occurs during intense lateral display and may also follow copulation.

Postural displays of this species have been described and illustrated by Kozłowa (1947), Taber (1949), Cramp and Simmons (1980), and Glutz (1973). One of the most important is wing-whirring, which normally occurs in association with crowing. The male typically selects a prominent location, draws his body up, pauses, and, sometimes after an inaudible wing-flap, utters his crowing call and almost immediately performs a brief but vigorous wing-whirring (Fig. 30). During this display the tail may be slightly cocked, or held down against the ground as an apparent brace, more commonly the former. These displays may occur every 10 to 15 min during the peak of the display season, but are most common in early morning and late afternoon. During this and other displays the facial wattles are engorged and the ear-tufts are raised. When two displaying males encounter one another they may face each other or walk parallel, holding their heads high, the wattles swollen, and the plumage on the back of the neck erected, while uttering a hoarse *krrrah* note. They may also perform a lateral intimidation display, with wing-lowering on the nearer side as well as tail-tilting and partial tail-spreading, but with the head held high rather than low as in courtship. Or, the birds may face each other with heads held low, rumps raised, and tails straight out behind, sometimes pecking at grass, and uttering purring threat notes. This may grade into actual fighting, with biting and kicking by both males. The subordinate male or loser of an encounter retreats with his feathers sleeked against the body, and the wattles retracted. Females may likewise perform similar intimidation displays to one another (Glutz 1973).

When displaying sexually to a female, the male assumes a lateral display posture while strutting around the female in semicircles, holding the head in, the nearer wing drooped, the tail tilted toward the female, the body feathers fluffed, and the wattle engorged. A hissing sound is often associated with this posturing, and the tail feathers may be vibrated,

producing a fluttering sound. Tidbitting is also performed, with an associated vocalization of low notes uttered at the rate of about three per second (Stokes and Williams 1972), whilst the bird crouches and holds his folded tail high. Copulation is usually preceded by lateral display or tidbitting at least early in the season, but later the male may simply chase the female and attempt to forcibly mount her. Following copulation the male may renew his lateral displaying, but no other specific postcopulatory displays occur.

### **Reproductive biology**

#### *Breeding season and nesting*

The breeding season is highly variable throughout the native and introduced range of this bird. In the majority of its range in North America, the western Palearctic and Asia the birds breed from about early or mid-March until early June. A variety of factors, including age of the female, annual variations in local temperatures, and individual physiological differences among females probably all contribute to laying phenology. Individual females' laying times may be set, within the general limits set by photoperiodic timing mechanisms, by her physiological condition at the end of the winter, and how rapidly she is able to accumulate the necessary energy reserves associated with egg-laying requirements (Gates and Hale 1975). Because of persistent re-nesting efforts, laying and hatching dates may be spread over a period of several months, (Wagner *et al.* 1965), although peak hatching dates are likely to vary from year to year only by a few weeks in most areas.

Nests are normally constructed on the ground, in thick grassy, weedy or shrubby vegetation. Occasionally, however, elevated sites such as straw stacks, old tree nests of other birds or squirrels, may be used. Some factors affecting nest-site selection in this species were discussed in Chapter 7. Relative nest concealment, as influenced by the surrounding height and density of the vegetation, seems to be especially important in site selection; there is less evidence that the overall size of the nesting habitat is important and no good evidence that the nest location is significantly related to the distance to the nearest habitat edge (Hoffman 1973). Nests often appear to be clustered within the presumed limits of a male's crowing territory, and perhaps the males adjust their territorial boundaries to include their mates' nest sites (Baskett 1947; Seubert 1952). Dumke and Pils (1979) found that females tended to locate their nests less than a kilometre away from their wintering range, and typically at the edges of their prenesting range and the territories of associated males.



**Fig. 30.** Postures of male common pheasant, including normal (A) and facial engorgement (B), crowing (C), wing-flapping (D), and lateral display to female (E). After various sources, especially Glutz (1973).

Eggs are laid at the rate of somewhat less than one a day, averaging about 1.4 days per egg for a complete clutch. Clutch sizes are highly variable, but a sample of 236 in Switzerland averaged 11.9 eggs, and 210 English clutches averaged 11.8 (Cramp and Simmons 1980). A sample of 4940 clutches from the North American and New Zealand populations of pheasants had a collective mean of 10.6 eggs, with individual means ranging from 8.6 to 12.6 eggs (Trautman 1982). A Wisconsin sample of 574 clutches that averaged 11.2 eggs (Gates and Hale 1975), had statistically significant yearly differences in average clutch size, with a seasonal decline in average size as well. Clutches begun after 15 May in

Wisconsin, presumably mostly or all renesting efforts, averaged 10.0 eggs, while those begun earlier averaged 12.5 eggs. Up to three renesting efforts have been observed following earlier clutch losses; Seubert (1952) observed that 57 per cent of 132 females that had been disrupted from or deserted their first nest established second nests, and that 7.5 per cent of those disrupted from their second nests attempted a third nesting. In a more recent study, Dumke and Pils (1979) found that 69 per cent (32 of 47 birds) of the unsuccessful females they studied renested a first time, 41 per cent (at least 11 of 27 birds) renested a second time, and one of 11 females renested a third time. All told, these birds averaged



1.8 nests each, and an estimated 75 per cent of the females succeeded in producing broods. Four females were determined to have renested following the loss of broods. Similarly, Penrod, Dixon, and Smith (1981) found that four females that had lost their broods at hatching or early in the brooding period renested.

#### *Incubation and brooding*

Incubation is performed entirely by the female, and under natural conditions requires from 23 to 28 days, averaging 23–23.5 days, with the longer periods associated with varying levels of disturbance to the incubating bird. Chicks are cared for entirely by the female, with no male involvement at all. The young are precocial and largely self-feeding from the outset. They average from 22 to 24 g at hatching, and at hatching males can sometimes be distinguished by their somewhat larger pale buffy eye-ring and less conspicuous brownish ear-flecks. A high rate of sex identification in young is also possible by the presence in day-old or older males of a rudimentary wattle (an unfeathered and nearly unpigmented fold or flap of skin), largely hidden by the down but usually evident directly under the eye region and in the loreal area above and in front of the eye (Woeler and Gates 1970). By about twelve days young are able to make their first flights. At thirty days they average about 135 g, at two months about 400 g, and at three months females average 750 g and males about 850–950 g (Glutz 1973). By 20 weeks of age the weight gain in females is essentially over and their average weight is about 800 g, while at the same age males are still growing slightly and average about 1100 g (Baxter and Wolfe 1973). The brood typically remains with its mother for about 70 or 80 days before becoming independent. Brood losses between hatching and independence from their mother are usually substantial, often amounting on average to nearly half of the total number of hatched young. Both sexes become sexually mature and attain full adult plumage in their first year of life.

#### **Evolutionary history and relationships**

Obviously the nearest relative of the common pheasant is the green pheasant, and the two should be considered no more than allospecies if not indeed simply subspecies. Where both of these forms occur together as a result of introductions of one or both, they tend to hybridize and the green pheasant typically suffers (Kuroda 1981; Schwartz and Schwartz 1951). The two forms are considered subspecies in the most recent (1983) edition of the *Check-list of North American Birds* (American Ornithologists'

Union), but were considered as full species by Vaurie (1965). Otherwise, the genus *Syrnaticus* seems clearly to be the nearest relative of *Phasianus*; the Reeves' pheasant in particular is extremely suggestive of the *Phasianus* plumage pattern, and the copper pheasant has been considered by some (e.g. Yamashina 1976) to be congeneric with the common pheasant. I see no major advantage in merging these two genera inasmuch as *Syrnaticus* is already reasonably large, and furthermore there are problems of reduced hybrid fertility involving crosses between *Phasianus* and *Syrnaticus*.

#### **Status and conservation outlook**

This is one species that conservationists need not worry about; the total world population of pheasants may number in excess of 50 million, with annual harvests in North America alone sometimes approaching 20 million birds, and with over seven million hand-raised birds released every year in Great Britain for sporting purposes. In some districts of New Zealand there is an annual kill of several thousand birds annually (Westerskov 1963), and a substantial amount of hunting also occurs in Hawaii where the 1946–47 population was some 70 000 birds. The pheasant population in the USSR cannot be known with any certainty, but in Tadzhikistan alone the autumn population may be about 1.5 million birds (Dementiev and Gladkov 1967). Likewise the population and harvest in China are completely unknown.

#### **GREEN PHEASANT**

*Phasianus (colchicus) versicolor* Vieillot 1825

Other vernacular names: Japanese pheasant; faisan versicolore (French); bunt Fasan, grün Fasan (German).

##### *Distribution of species*

Japan, in park and farmland, brushy sites, and open woods in the plains or lower slopes of the mountains where it ascends to about 3500 ft (Vaurie 1965). Absent from Hokkaido, See map 17. Locally introduced on the Hawaiian Islands (Hawaii, Kauai, Lanai, perhaps Maui).

##### *Distribution of subspecies*

*Phasianus (colchicus) versicolor* Vieillot: southern green pheasant. South-west Honshu and Kyushu.

*Phasianus (colchicus) tanensis* Kuroda: Pacific green pheasant. Peninsulas of Izu and Miura in eastern Honshu, the Seven Islands of Izu and the islands of Tanegashima and Yakushima south of Kyushu.



**Map 17.** Distribution of northern (N), Pacific (P), and southern (S) races of green pheasant.

*Phasianus (colchicus) robustipes*: northern green pheasant. Islands of Sado and Honshu (excepting regions inhabited by nominate *versicolor* and *tanensis*) and possibly Shikoku.

### Measurements

Delacour (1977) reported that males have wing lengths of 196–220 mm, and tail lengths of 270–425 mm, while females have wing lengths of 195–220 mm and tail lengths of 207–275 mm. The southern race *versicolor* averages slightly larger than *robustipes*, with wing lengths of males being 225–243 and 215–225 mm, respectively. Males average about 900–1100 g, and females about 800–900 g (Bohl 1964). Eggs average  $43.3 \times 34$  mm, and have an estimated fresh weight of 27.8 g.

### Description (after Ogilvie-Grant 1893)

#### Adult male

Distinguished from all other forms of *Phasianus* by having the whole of the chest, breast and flanks uniform dark green; the top of the head is bronze-green as in *P. colchicus*; the mantle is dark green, shot with purple and marked with lines of buff, mostly following the shape of the feathers; the upper

tail-coverts are uniform greenish slate, without any rust-coloured feathers on each side as is the case with *colchicus*.

#### Female

Closely resembles the female of *colchicus*, but the feathers of the mantle are almost entirely black in the middle, sometimes with a thin shaft-streak of rufous, and the green tips to the feathers are usually well-marked; the black bars on the feathers of the chest, breast, and flanks are also much more strongly marked.

#### Juvenile

Similar to the female, with developmental changes as in *colchicus*.

### Identification

#### In the field (18–31 in.)

Limited to Japan, this species is likely to be confused only with the copper pheasant there, except on Hokkaido, where the common pheasant has been introduced and is expanding in range. Separation from the copper pheasant is easily achieved by the green pheasant's absence of coppery brown head and body colouration in males. Females are more similar, but the female copper pheasant has a white-tipped and otherwise weakly patterned tail. Field separation of female common and green pheasants is probably not possible. Male calls are said to be shorter and distinguishable from those of the common pheasant.

#### In the hand

The green pheasant is easily confused with the common pheasant, especially the latter's melanistic mutant variety. However, males of the latter form are generally more dark-coloured, and have a longer (over 350 mm) tail. They also are almost entirely sooty black, with greenish to bluish iridescence on the head, neck, breast, and mantle, heavy black barring on the tail, and olive-black wings. Female pheasants closely resemble those of *colchicus*, but average darker and have more distinctively patterned body colouration. The dark parts of the mantle feathers are black, often with a greenish sheen, and the underparts are more vermiculated and blotched than is true of *colchicus*.

### Geographic variation

Geographic variation in this species is limited and probably is somewhat clinal, although a good deal of local variation also occurs. In general, birds from more northern areas are lighter and greener than those from farther south, which tend to be darker



and bluer. Northern birds are said to be slightly smaller than southern ones (Delacour 1977), although this is not a clear-cut trend and indeed Kuroda (1981) has stated that the northern race actually averages slightly larger.

## Ecology

### *Habitats and population densities*

The northern populations of the green pheasant extend from sea level to about 3500 ft elevation, in sparse woods or brush lands near cultivated fields, grassy areas near rivers and cultivated lands, low hilly areas near the coast, and on island mountains having brush and tree cover. The southern population on Kyushu is found in similar habitats but generally more luxuriant vegetation, with a greater proportion of broad-leaved trees. Introduced populations on Hawaii occur at elevations centring between 4000 and 7500 ft, with densest populations where there are scattered clumps of koa trees (*Acacia koa*) interspersed with grassy meadows with mixed herbaceous vegetation (Schwartz and Schwartz 1951).

There do not seem to be any detailed estimates of population densities, although Kuroda (1981) mapped the local distribution of a flock using a very limited area near the Imperial Palace, and his map is suggestive of a density of up to several birds per hectare under highly favourable conditions.

### *Competitors and predators*

There are only limited ecological contacts between the green pheasant and the copper pheasant in Japan (Yamashina 1976), and these seem to occur primarily during cold weather when the copper pheasant is forced into lower altitudes. Avian predators in Japan include various hawks; additionally crows, ravens, and magpies may be nest predators, as perhaps are weasels and snakes. However, feral cats and dogs are probably this species' major enemy in Japan (Bohl 1964; Beebe 1918–1922).

## General biology

### *Food and foraging behaviour*

This species' foods are very similar to those of the common pheasant, with possibly a somewhat higher proportion of wild seeds, fruits, berries, and nuts in the diet, and lower proportions of cultivated grains. Fruits that are utilized include those of such genera as *Rosa*, *Euonymus*, *Viburnum*, *Viscum*, and *Diospyros*, and mast includes acorns, chestnuts, and the seeds of Japanese magnolias. Cultivated grains include millet, wheat, barley, rice, soybeans, and

buckwheat, and sweet potatoes are also eaten. A considerable array of insects are consumed, many of which are considered harmful, and additionally millipedes, crustaceans, and snails have all been reported as food items. Young birds take a high proportion of animal foods (Bohl 1964).

Foraging is done during morning and evening hours near agricultural fields, tea plantations, and open grasslands, often in small groups.

## Movements or migrations

Evidently the only significant movements occurring in this species are those associated with the higher snowfall areas of northern Honshu, where movements to lower elevations and the seashore during severe winter weather occurs. Deep snow may also cause the birds to move into farmyards and feed with domestic fowl. Daily movements consist of small vertical movements associated with the birds moving out of hillside roost areas into croplands or adjacent areas for foraging, followed by a return to the hillsides for resting and dusting. A second movement back to the foraging areas occurs in late afternoon (Bohl 1964).

### *Daily activities and sociality*

As just mentioned, foraging occurs twice a day, with the middle of the day being spent on hillsides, preferably in sandy areas where dusting is also performed. The roosting sites are typically on grassy areas at or near hilltops, but where this type of cover is lacking the birds may roost in brushy vegetation, or sometimes also in trees (Bohl 1964).

Large flocks of birds are typical only in winter, when feeding restrictions may force birds into close proximity. Otherwise, only small groups are typically found, and during spring the usual grouping is a single male and one or more females. Following the nesting season the male may rejoin his females and their broods, or may flock with other males during the autumn and winter seasons (Bohl 1964). Kuroda (1981) stated that during winter males may remain alone, occur in groups of up to four, or sometimes may be seen as apparently paired birds. Females in winter also often occur in groups of up to six birds; the chicks evidently remain with them only until about September.

## Social behaviour

### *Mating system and territoriality*

Beebe (1918–1922) believed that males are essentially polygynous, with the birds beginning to mate in March, and the breeding season extending through May. However, there are marked local vari-

ations in the onset of laying, with some beginning as early as January in Kyushu, and as late as the latter part of April in northern Honshu (Bohl 1964). Kuroda (1981) found a small population near Tokyo to be more often monogamous than polygynous.

These birds are said to be territorial, the males performing crowing calls during the breeding season. According to Kuroda, male calling occurs from mid-March through April and May (in the Tokyo area), and fades out by about the first week of June. He mapped the locations of a considerable number of 'suggested' territories, reporting in one case 36 male territories within an area of approximately 16 ha, the males thus having an average territory of less than half a hectare. This was in a protected area near the Imperial Palace, and probably reflects a very high population density.

#### *Voice and display*

The crowing call of the male is said to be shorter and somewhat different from that of the common pheasant; a sonogram of the call (Kuroda 1981) indicates

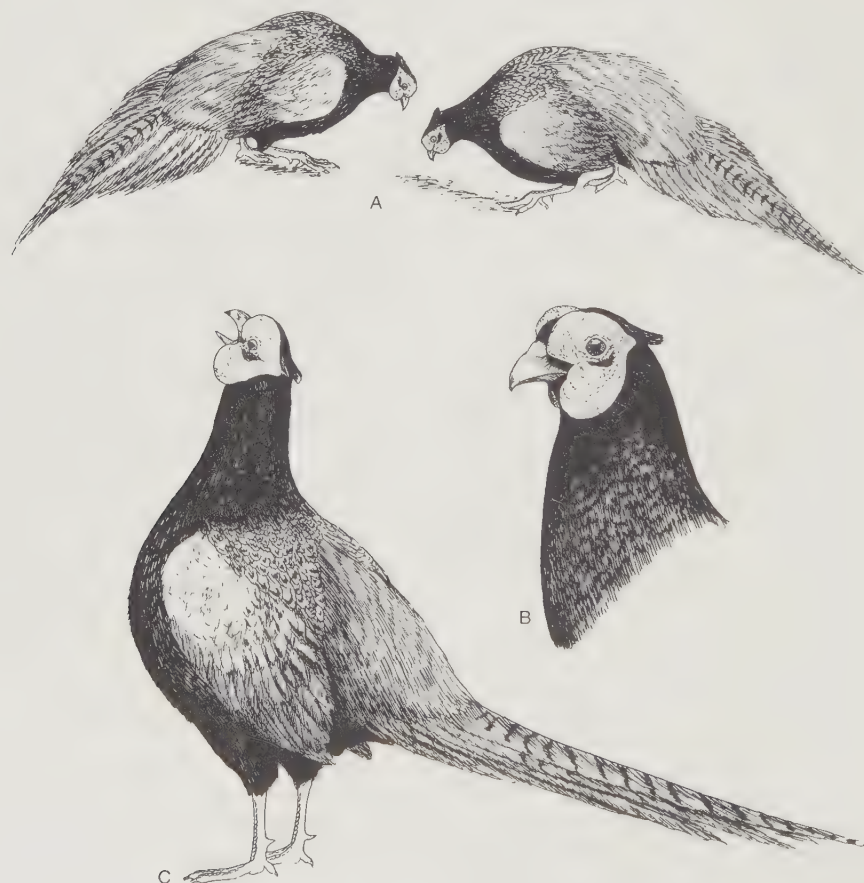
that it is a double-noted call and is rather different in minor acoustic characteristics from that of the common pheasant (compare sonogram of common pheasant on p. 511 of Cramp and Simmons 1980).

The postural displays of this species are apparently very much like those of the common pheasant (Fig. 31), including a crowing posture followed immediately by wing-whirring, and a lateral threat and/or courtship posture which would seem to be identical to that of the common pheasant. Beebe (1918–1922) stated that the courtship display differs in no way in these two species.

### **Reproductive biology**

#### *Breeding season and nesting*

The maximum period of egg-laying probably coincides with the peak of crowing behaviour in males, or April and May in central Japan. The nests are placed on the ground in various cover, but commonly are close to low bushes or at the bases of



**Fig. 31.** Postures of male green pheasant, including males in mutual lateral threat display (A), facial engorgement (B), and crowing posture (C). After Kuroda (1981).



trees. Nests have been located from sea level to as high as about 3000 ft, and the usual clutch-sizes are from 6 to 12 eggs, with an extreme of 15 reported. Renesting occurs if the first nest is disturbed or destroyed, and such nests may be seen from late June until August (Bohl 1964).

#### *Incubation and brooding*

The female incubates the eggs, without any apparent nest defence on the part of the male, for from 23 to 25 days.

#### *Growth and development of the young*

Kuroda (1981) reported that observed brood sizes ranged from one to eight chicks, with a mode of only two chicks per brood and an estimated mean of 3.3 for a rather small sample size (about 34 sightings). June was the month in which the largest number of sightings of females with broods were obtained, and by September these family groups had virtually disappeared. This apparent early breakup of family units is surprising, and needs confirmation.

Like the common pheasant, these birds mature in their first year.

### **Evolutionary history and relationships**

There can be no doubt that this form is extremely closely related to the common pheasant, and that they can be considered no more than allospecies. There is indeed doubt whether they should not be simply considered as subspecies (Goodwin 1982). Probably the birds arrived in Japan via Korea when these land masses were still connected (Kuroda 1981).

### **Status and conservation outlook**

The green pheasant is a major game bird in Japan, and probably represents the most popular game bird in that country. Annual harvests of more than half a million birds a year are now typical, and 100 000 captive-raised birds are released per year. Where the common pheasant has been released in Japan there have been deleterious genetic effects on the native population. Thus the common pheasant cannot now be legally released there except on Hokkaido and other remote areas not already occupied by the green pheasant (Kuroda 1981).

# 12 · Genus *Chrysolophus* J. E. Gray 1834

The ruffed pheasants are small montane pheasants in which sexual dimorphism is strongly developed, the tail is greatly elongated and slightly vaulted, and in which the males have short decumbent crests and ornamental 'capcs' or ruffs, which can be spread during display. The body feathers of males are mostly either disintegrated and silky, of whites, yellows and reds, or broad and scaly in pattern. The tail is strongly graduated, of 18 rectrices, is strongly barred or mottled, and partially covered by brightly patterned upper tail-coverts. The tail moult is phasianine (centripetal). The wings are relatively short and rounded, with the sixth primary the longest, and the ninth and tenth both shorter than the first. The tarsus is relatively long and thin, and spurred in the male. There is a small orbital skin patch, which includes a wattle under the eye that can be expanded during display into a lappet. Females are barred with dark brown and buff, and their orbital area is sparsely feathered. Two species are recognized.

## KEY TO SPECIES OF *CHRYSOLOPHUS* (after Delacour 1977)

- A. Dominant plumage colours yellow and red, or white and green (males).
  - B. Ruff white, barred with black; abdomen white: Lady Amherst's pheasant.
  - BB. Ruff orange, barred with black; abdomen red: golden pheasant.
- AA. Dominant plumage colour brown (females).
  - B. Legs greyish, orbital skin bluish: Lady Amherst's pheasant.
  - BB. Legs and orbital skin yellow: golden pheasant.

## GOLDEN PHEASANT

*Chrysolophus pictus* (Linnaeus) 1758

Other vernacular names: painted pheasant; faisan doré (French); Goldfasan (German); kin-ky, ching chi (Chinese).

### *Distribution of species*

Mountains of central China from south-east Tsinghai eastward through southern Kansu to southern Shensi north to the Tsinling Range, southward through Szechwan, Kweichow, western Hupeh

and western Hunan to northern Kwangsi. Occurs on mountain slopes and valleys in habitats well grown with bushes, bamboos or other dense cover, occasionally in bushes or scrub on tea plantations or terraced fields (Vaurie 1965). Introduced locally in Great Britain. See map 18.

### Measurements

Cramp and Simmons (1980) reported that males have wing lengths of 190–202 mm, and tail lengths of 630–765 mm, while females have wing lengths of 179–190 mm, and tail lengths of 340–372 mm. The dark variant '*obscurus*' is slightly larger, with male wing lengths of 194–209 mm, and female wing lengths of 185–193 mm. Five males ranged in weight from 575–710 g, and five females ranged from 550–665 g (Cheng *et al.*, 1978). The eggs average 44 × 34 mm, and have an estimated fresh weight of 28.1 g.

### Description (after Delacour 1977)

#### *Adult male*

Head fully crested, the crown covered with elongated, stiff, silky feathers of a bright golden yellow; ear-coverts fulvous grey; rest of face, chin, throat and sides of neck rusty red; ruff composed of broad, square feathers, pale fulvous changing to light orange on their exposed parts, which are bordered by two bluish black cross-lines; upper back dark green, each feather with a velvety black border; rest of the back and rump deep golden yellow, the fringes of the feathers disintegrated, becoming scarlet on the sides; central tail feathers black, profusely spotted and tipped with cinnamon-buff; other rectrices irregularly barred black and cinnamon; upper tail-coverts similar at their bases, with long, narrow stiff tips of a deep scarlet; scapulars dark red; tertials and their coverts deep blue; secondaries and their coverts barred chestnut and black; primaries dark brown blotched with pale buff; entire underparts scarlet, the feathers with disintegrated fringes, becoming light chestnut on the centre of the abdomen and the thighs; under tail-coverts scarlet. Iris, wattle, and orbital skin light yellow; bill and legs horny yellow.





**Map 18.** Distribution of Lady Amherst's (A) and golden (G) pheasants. See text for introduced populations.

#### *Female*

Crown and neck blackish brown spotted with cinnamon-buff; face and throat buff; ear-coverts silvery grey striped with blackish; mantle barred blackish brown and light rufous buff; back, rump, and upper tail-coverts rufous, finely streaked and peppered with black; tail rufous brown with irregular black bars and vermiculations, pointed, and lighter at the tip; wing-coverts, tertials, and secondaries like the mantle but with coarser bars; thighs and under tail-coverts barred. There is some individual variation in the extent of the buff. Iris brown, orbital skin yellow, bill and legs horny yellow.

#### *First-year male*

Crown rusty red, the forehead and sides bright and uniform, the centre much spotted with black, becoming greyish on the small ruff; ear-coverts greyish, rest of the face and throat rusty red; mantle, wings and underparts like those of the female, but brighter; back, rump and upper tail-coverts rusty red, finely barred with black; central rectrices rather

short, black spotted with buffy chestnut; other rectrices irregularly barred.

#### *Juvenile*

Like the female, but paler, and with less distinct barring.

#### **Identification**

##### *In the field* (20–46 in.)

Excepting its limited introduced range in Great Britain, this species is found only in the mountains of central China, where it occurs in dense scrub and broken country. Feral birds in Britain favour dense woodlands with closed canopies, but with clearings for foraging. The adult male is unmistakable, owing to its golden nape and the orange-red feathers of the underparts and rump. Females are much duller, but having barring in a more distinct pattern than occurs in female common pheasants, and this is especially evident on the wings and tail. The species' voice is more piercing than that of the common pheasant,

and the male has a higher-pitched crow, which is either a strident and metallic *chak*, or a double *cha-chak*. This metallic sound, resembling the whetting of a scythe, can be heard for as much as 500 yd, and is repeated every few minutes during the courtship season.

#### *In the hand*

Males can be readily recognized in the hand by their golden cape and rump, and their brilliant reddish underparts and ornamental tail-coverts. Females are most likely to be confused with those of the Lady Amherst's but have yellow orbital skin, have yellowish rather than reddish chestnut on the crown, and are less heavily barred with blackish throughout.

### **Ecology**

#### *Habitats and population densities*

Beebe (1918–1922) found these birds on steep, rocky and barren ridges, with only a dense growth of scrub bamboo present, in Hopeh Province. A similar habitat preference has been described by Cheng (1963); the species evidently avoids heavy forests, open country, and wetland habitats. Their altitudinal range rarely extends above 6500 ft. In Great Britain introduced birds favour dense plantations of Scots pine and larches, especially those from 15 to 30 years old, and to a lesser extent are found in mixed woodlands. Lowland areas with extensive undisturbed cover are their preferred habitats there (Cramp and Simmons 1980).

There are no estimates of population densities.

#### *Competitors and predators*

There is apparently no contact between the golden pheasant and the very closely related Lady Amherst's pheasant in China, the former's only probable serious competitor. The species possibly has local contacts with both the Reeves' and common pheasant, Beebe (1918–1922) found no obvious associations with other animals, nor evidence of any definite predation, but did find some scattered feathers that he judged may have been the result of owl or eagle attacks.

### **General biology**

#### *Food and foraging behaviour*

According to Cheng (1963), in China the species' foods are primarily the leaves and tender shoots of shrubs, the leaves and shoots of low-growing bamboos, the flowers of a species of rhododendron, and some spiders and various insects, especially small

beetles. There are no data on the foods of the introduced populations.

#### *Movements and migrations*

In Great Britain, the introduced population is believed to be sedentary (Cramp and Simmons 1980). Beebe (1918–1922) judged that there is likely to be relatively little population shifting with the seasons, but Cheng (1963) said that in winter the birds move down out of the mountains to lower levels each day to look for food, and then go back uphill each evening to roost.

#### *Daily activities and sociality*

Beebe (1918–1922) found two roosting sites, both of which were in pine trees not more than 12 ft above ground, on horizontal branches about halfway up the tree. In one case, a pair were roosting side by side, while in the other two birds roosted on opposite sides of the tree. The birds are found as single individuals, pairs, or trios throughout the year; Beebe (1918–1922) found no evidence of flocking in this species.

### **Social behaviour**

#### *Mating system and territoriality*

The mating system in the wild is not certain, but in the majority of observed cases the males were apparently associated with only a single female, although occasional polygyny is likely (Beebe 1918–1922). In captivity polygynous matings are usual. A single male may be easily kept with two or three females (Wayre 1969), while as many as eight females fertilized per male have been mentioned (Rutgers and Norris 1970).

During spring, male crowing is the best evidence of territoriality in these birds. Beebe (1918–1922) was able to hear at least four males calling from a single point, and he believed that this calling is done from a single point. Beebe also thought that calling is done from the immediate vicinity of roosting sites. Calling begins in early morning, and evidently carries several hundred yards, where it might be answered by some other resident male.

#### *Voice and display*

The crowing call of males is a loud, metallic *chac*, or *cha-chak*, lasting about half a second, and very penetrating. This is uttered by the male only, primarily in spring, but rarely also is uttered in fall and winter. Other major vocalizations associated with sexual display include a 'dance-call' by the male, which is a series of varied squeaking, liquid, sharp, and excited-sounding notes, given by the male as he is running to display to the female, and a food-call that is presumably given during tidbitting display. Males also



utter a very loud hiss during the last phase of lateral display, which may be heard for up to 50 m. Several other vocalizations associated with excitement, threat, alarm, and fear are also present (Cramp and Simmons 1980).

The postural displays of this species are highly developed, and have often been described from captive birds (Cramp and Simmons 1980; Cheng *et al.* 1978). Beebe (1918–1922) also observed comparable displays in a wild male. Unlike *Syrnaticus* and *Phasianus*, there does not appear to be a wing-whirring display in this species. Lateral threat display toward other males seems to be similar to that used in heterosexual encounters, with the birds approaching one another sideways, with tails spread, and bodies held in a position ready to attack. Attacks are made by rapid stabbing with the beak or with kicking of the spurred tarsus. The lateral display toward females is posturally apparently identical to that of the Lady Amherst's pheasant. The male repeatedly runs around the female, in wide circles or semicircles, attempting to block her movements and, when doing so, stopping and in a sudden rush assuming a static display posture, with his eye held as close to the female's head as possible (Fig. 32). At the same time, the cape is drawn around the neck on the side nearer the female, forming a patterned series of concentric circles around the male's eye, whilst the pupils of the eye are contracted to pinpoints. Simultaneously the wing nearer the female is lowered slightly, the body is tilted toward her to expose the rump and back, and the tail is slanted while the tail-coverts are spread maximally. While this posture is held briefly, the bird suddenly utters a sharp hiss. After an extended series of such male displays, the female tends to turn and move away progressively less. The male may follow her or move toward her, and attempt to place his foot on her back. At times the female may crouch and invite copulation. Actual courtship-feeding, or tidbitting, by the male has been only rarely observed in this species, although Stokes and Williams (1972) reported it for the Lady Amherst's pheasant. While copulating, the male pecks at the female's head, and as soon as cloacal contact occurs the female breaks free and flies up to a perch (Cramp and Simmons 1980). There is relatively little wattle engorgement in this species, which may be related to the fact that the cape display tends to hide nearly all of the male's head below the level of his eyes.

## Reproductive biology

### *Breeding season and nesting*

According to Beebe (1918–1922), breeding in central China begins in April. In Great Britain the eggs are

laid in April and May (Cramp and Simmons 1980). There is almost no information on nesting in the wild, but apparently one clutch was found in a bamboo grove, where the weeds were more than a foot tall and there were many rocky outcrops (Cheng 1963).

### *Incubation and brooding*

In captivity, clutches range from five to 12 eggs, and the eggs are laid at approximate 24 hr intervals. The male takes no interest in defending the nest or looking after the chicks, but instead tends to distract and drive the females (Rutgers and Norris 1970). The incubation period requires 22–23 days, usually the former.

### *Growth and development of the young*

The female remains almost totally immobile during incubation, but after hatching has occurred she does little other than brood her chicks for the first few days. Later, she calls them to her when she has found a food item, and usually offers it beak-to-beak, or sometimes drops it in front of them. The young are apparently able to fly within 12 to 14 days after hatching, and are cared for by the female until they are about four months old, or essentially fully grown. The birds begin to become sexually active in their first year, when females typically lay, but males of that age are not yet in their final adult plumage or full vigour. Thus, probably rather few first-year males are able to mate successfully even though they are sometimes able to fertilize eggs. However, maturity is attained the following spring. Second-year and older birds may also court females for a brief period in late summer, ceasing again in September (Cramp and Simmons 1980).

## Evolutionary history and relationships

Delacour (1977) judged that the genus *Chrysolophus* has affinities both with *Phasianus* and with *Polyplectron*, resembling the latter in its call-notes, and the former in its crowing behaviour. Certainly the two species share hissing during intense male display with both *Syrnaticus* and *Phasianus*, but apparently they lack the loud wing-whirring typical of both these genera. Their downy young are more like those of *Phasianus* than *Polyplectron*, and I do not agree that they are distinctly transitional between these two genera. Hybrids with the Lady Amherst's pheasant are fully fertile, but those with the cheer pheasant are sterile. Hybrids with the silver pheasant have produced sterile females but fertile males, whilst among those with common, green and Reeves' pheasants only some of the males are fertile (Rutgers and Norris 1970). This would suggest



Fig. 32. Postures of male golden pheasant, including lateral display to female (A), normal posture (B), and expanded cape display (C). After various sources.

that both *Lophura* and the *Syrmaticus-Phasianus* group are probably the nearest relatives of *Chrysolophus*.

#### Status and conservation outlook

Nothing is known of this species' status in the wild, but the birds are regularly snared for their feathers and flesh. The birds are extremely wary, however, and probably they can apparently survive well under such levels of persecution (Beebe 1918–1922).

#### LADY AMHERST'S PHEASANT

*Chrysolophus amherstiae* (Leadbeater) 1829

Other vernacular names: none in general English use; faisan de Lady Amherst (French); Diamantfasan (German); wokree (Burma); seng-ky, kwa-kwa-chi (Chinese).

#### Distribution of species

From about lat. 31° N, from the region west of Kwanhsien in western Szechwan westward to the Salween River and south to north-east Burma, east to about lat. 23° N in Yunnan, and western Kweichow, ascending to 15 000 ft in the mountains of north-west Yunnan. Usually occurs at higher elevations and in colder regions than *C. pictus*, on wooded slopes, bamboos, or in other thickets and dense bushes (Vaurie 1965). Introduced locally in Great Britain. See map 18.

#### Distribution of subspecies

None recognized.

#### Measurements

Cramp and Simmons (1980) reported that males have wing lengths of 215–226 mm, and tail lengths of 830–950 mm, while females have wing lengths of



194–203 mm, and tail lengths of 286–318 mm. Tail lengths in males may attain a maximum of 1150 mm, while 375 mm is the maximum tail length in females (Delacour 1977). Cheng *et al.* (1978) reported that five males ranged in weight from 675–850 g, and five females from 624–804 g. The eggs average  $46 \times 35$  mm, and have an estimated fresh weight of 31.1 g.

### Description (after Delacour 1977)

#### *Adult male*

Crown covered with short metallic green feathers; narrow nuchal crest of stiff, elongated crimson feathers; ruff of rounded feathers, with a bluish black border; mantle and scapulars of rounded feathers, metallic bluish green with a black border edged with scintillant green; feathers of back broad and square, black with a green bar and a wide buffy yellow fringe; those of the rump with a vermilion fringe; tail-coverts mottled black and white with long orange-vermilion tips; central rectrices irregularly lined black and white with black cross-bars; other rectrices similar on the narrow inner web, silver grey becoming brown outside, with curved black bars on the outer web; wings dark metallic blue with black borders, but the primaries blackish brown sparsely barred with buff; face and throat black, with metallic green spots, breast like the mantle, the borders of the feathers wider and brighter; rest of the underparts pure white, the bases of the feathers grey, except the lower flanks and vent which are barred with black and brownish grey; thighs mottled white, black and brown; under tail-coverts black and dark green more or less barred with white. Iris pale yellow, bar facial skin and lappet bluish or greenish white; bill and feet bluish grey.

#### *Female*

Similar to *C. pictus*, but larger, the dark barring blacker, with a green sheen; crown, sides of head, neck, mantle, lower throat and upper breast strongly washed with reddish chestnut; upper throat and abdomen pale, sometimes white; lores, cheeks and ear-coverts silvery grey spotted with black; back strongly vermiculated; tail feathers rounded, not pointed at the tip as in *pictus*, and much more strongly marked with broad irregular bars of black, buff, and pale grey vermiculated with black. Iris brown, sometimes pale yellow or greyish in older birds; orbital skin light slaty blue; bill and legs bluish grey.

#### *First-year male*

Crown dark green; no crest, short ruff varying from dark grey to white with black and green bars; upper-

parts like those of the female, but black bars with greener reflections; upper tail-coverts long and rusty red; central rectrices pale grey with black vermiculations and cross-bars, brownish at the tip; other rectrices much as in the adult male; face, throat, and foreneck black with white spots; rest of underparts as in the female.

#### *Juvenile*

Like the female, but duller, less strongly marked, and reddish tinge on head weak or absent. Young males soon show a greyish ruff, reddish upper tail-coverts, and barred rectrices.

### Identification

#### *In the field* (26–67 in.)

This species is limited to central China, occurring south of the range of the golden pheasant but in similar woodlands, scrub and bamboo habitats, often on rocky ground. The extremely long and mostly white tail of the male, with heavy black barring, as well as the black-and-white scaly-patterned cape, are highly distinctive. Vocalizations are very similar to those of the golden pheasant. Likewise, females of the two species probably cannot be safely distinguished in the field, although female Lady Amherst's pheasants have tails that are much more heavily barred with black, buff and grey.

#### *In the hand*

Males can immediately be recognized by their long (at least 860 mm) tail, which is strongly barred with black and white, and their scaly black-and-white cape pattern. Females are similar to those of the golden pheasant but average larger (wing over 180 mm), are more darkly patterned on the body, and have a tail more heavily barred with black. Their orbital skin is light blue rather than yellow. Many captive-raised birds show varying degrees of intermediacy in these traits because of hybridization in previous generations.

### Ecology

#### *Habitats and population densities*

In the wild this species is found on high mountain slopes, usually between 7000 and 12 000 ft, but it occurs locally up to 15 000 ft in Yunnan, and typically lives in heavy bamboo cover or thorny thickets, but is not usually found in forests (Cheng 1963). The feral population in Great Britain is associated with woodlands having dense undergrowth, particularly brambles and rhododendrons (Cramp and Simmons 1980).

There are no available estimates of population densities.

#### *Competitors and predators*

This species evidently occurs at about the same level as does the common pheasant, and may also have some contacts with the koklass pheasant (Schäfer 1934). Nothing is known of its predators.

### **General biology**

#### *Food and foraging behaviour*

Beebe (1918–1922) noted that the crops of two males that he examined contained a mass of earwigs of several species, various spiders, small beetles, fern fronds, and fifteen bamboo sprouts. It is generally believed that the birds favour bamboo sprouts, which is the basis for a local name 'sun-chi' or 'Fowl of the buds'. When looking for food it searches amidst the pebbles and gravel at the base of shady bamboos, and may also wade in shallow water, turning over pebbles in an apparent search for invertebrates (Chen 1963). Cheng *et al.*, (1978) noted that grain, nuts, seeds, and grit were found in nine birds collected in Szechwan and Yunnan.

#### *Movements or migrations*

The birds live at considerably higher altitudes than do golden pheasants. They thus have more noticeable seasonal migrations, moving to the foothills during severe weather (Cheng 1963).

#### *Daily activities and sociality*

The largest groupings of this species are seen in autumn and winter, when groups of a male and one or two females are usual, but as many as 20 to 30 birds may at times be seen (Cheng 1963). These groups probably represent groupings of several families, and include females, young of the year, and some second-year males in full colour.

### **Social behaviour**

#### *Mating system and territoriality*

Beebe (1918–1922) observed a male mated to a single female in the wild, but also twice observed a male with two females present, which he considered to be the exception rather than the rule. In captivity the birds are certainly polygynous, and each male should be provided with three or four females, in the opinion of Rutgers and Norris (1970).

Territoriality is assumed to exist in this species, inasmuch as Beebe (1918–1922) reported hearing challenge calls in the wild.

#### *Voice and display*

No detailed studies or comparisons with the golden pheasant have been made, but it is believed that the two species have similar vocalizations (Wayre, 1969; Delacour, 1977; Cramp and Simmons 1980). Likewise, the display repertoires of these two species are virtually the same, if not identical. Stokes and Williams (1972) illustrated sonographically the tidbitting call of this species, which consists of 3–4 calls per second, each note very short and with a slight upward inflection, very similar to that of *Phasianus*.

### **Reproductive biology**

#### *Breeding season and nesting*

Little is known of the breeding season in the wild, but it is believed to begin early, probably about the beginning of April, and continue through May and into June. There appear to be only two records of clutches taken from the wild, and these are probably incomplete clutches of four and seven eggs. Both were found in heavy forests where they had been laid under the protection of a bush (Baker 1930).

#### *Incubation and brooding*

In captivity, clutch sizes of 6–12 eggs are usual, at least for females two years old or older, and they are probably laid on a daily basis. As with other pheasants, incubation begins with the laying of the least eggs, and lasts some 22–23 days, more often the former. The male plays no role in nest protection.

#### *Growth and development of the young*

As with the golden pheasant, only the female tends the young, which grow at a relatively rapid rate. Seven newly hatched chicks at the San Diego Zoo weighed an average of 24.1 g at hatching, and 149 g at 30 days. At 40 days five of them averaged 207 g (David Rimlinger, personal communication). Males do not acquire their full adult plumage until they are two years old, but females often lay eggs their first year. Like golden pheasants, males may also exhibit sexual activity as yearlings, but have limited reproductive success.

### **Evolutionary history and relationships**

The affinities of *Chrysolophus* with other genera have already been discussed. The relationships of the golden and Lady Amherst's pheasants to one another may warrant some additional comments. Hybridization experiments involving these two species have been performed repeatedly, and in all cases the conclusion of Phillips (1921), that first-generation hybrids are fully fertile, seems to have been con-





Fig. 33. Postures of male Lady Amherst's pheasant, including lateral display (A), expanded cape display (B), and lateral display to female from opposite side (C). After various sources.

firmed. Phillips also reported, however, that the  $F_1$  hybrids, when bred *inter se*, exhibited less segregation of male plumage characters than might be expected between two such seemingly closely related species, and apparently less, for example, than second-generation crosses between the silver pheasant and black-backed kalij that he also bred. Danforth (1950) did some further plumage-inheritance experiments, but concentrated on the male plumage characteristics of *Chrysolophus*  $\times$  *Phasianus* hybrids. Baker (1965) found that he could not separate golden and Lady Amherst's pheasants using starch-gel electrophoresis of egg-white proteins, although he did observe some polymorphism in the albumin component, which apparently varies between these two forms, with the golden pheasant apparently having lost one of three electrophoreti-

cally separable types of albumin in the course of speciation. My own interpretation of the available data is that the two forms should be considered a super-species complex.

#### Status and conservation outlook

Nothing can be said about the status of this species in the wild, but like the golden pheasant it is reportedly very wary and is found in even more remote habitats than is that form. Thus, in the absence of other information, it may be assumed that the population is in no obvious danger. Both forms breed extremely freely in captivity, and feral but apparently viable populations have been established in Great Britain. Attempts to introduce the species elsewhere have been failures (Long 1981).

# 13 · Genus *Polyplectron* Temminck 1813

The peacock pheasants are small to medium-sized tropical pheasants, in which sexual dimorphism is moderately developed, and the tail is rounded to graduated, with iridescent bluish green ocelli or banding in males. Bare orbital areas are inconspicuous to only moderately developed in males, wattles are lacking, and crests are short to moderate in length. The tail is variably graduated, with 16 to 24 rectrices, and with long and broad upper tail-coverts. The wing is strongly rounded, with the ninth and tenth primaries both shorter than the first, and the fourth being the longest. In most species the upper wing-coverts, inner secondaries, longer upper tail-coverts and rectrices are marked with rounded iridescent ocelli or more diffuse iridescence, which is exposed during display. The tail is moulted in a pattern beginning with the third from the central pair and proceeding outwardly and inwardly, the second and first pairs being moulted between the fourth and fifth, and the fifth and sixth pairs respectively. The tarsus is long, and has from one to three short spurs in males. Females are unspurred, considerably smaller than males, duller in colour, and, although sometimes having mantle ocelli, usually lack iridescence. Seven species are recognized here.

## KEY TO SPECIES (AND SUBSPECIES OF MALES) OF *POLYPLECTRON*

- A. Central rectrices with poorly developed ocelli or none; bare facial area in adults very small.
  - B. Wing at least 180 mm; 2–5 spurs present (males).
    - C. Head and neck grey, mantle with iridescent ocelli: Rothschild's peacock pheasant.
    - CC. Head and neck brownish black; mantle lacking ocelli: Sumatran bronze-tailed pheasant.
    - D. Upperparts less strongly marked: south Sumatran bronze-tailed pheasant (*chalcurum*).
    - DD. Upperparts more strongly marked: north Sumatran bronze-tailed pheasant (*scutulatum*).
  - BB. Wing under 180 mm; no spurs present (females).
    - C. Head and neck grey: Rothschild's peacock pheasant.
    - CC. Head and neck brownish grey: Sumatran bronze-tailed pheasant.
- AA. Central rectrices with well developed ocelli; large bare facial area in adults.

B. Mantle and wing coverts with metallic ocelli, tarsi spurred; head crested (males).

C. Ventral plumage brown; sides of breast not iridescent, tail without dark subterminal banding or spotting.

D. Outer tail feathers without ocelli on inner webs; tail under 350 mm: Malay peacock pheasant.

DD. Outer tail feathers with ocelli on inner webs; tail over 350 mm.

E. General colour dark blackish grey; throat not white; facial skin reddish: Germain's peacock pheasant.

EE. General colour light grey; throat white; facial skin yellowish: grey peacock pheasant.

F. Ocelli of rectrices surrounded by wide buffy grey bands.

G. Larger (wing usually over 200 mm): Ghigi's grey peacock pheasant (*ghigi*).

GG. Smaller (wing under 200 mm): Hainan grey peacock pheasant (*katsumatae*).

FF. Ocelli of tail not surrounded by wide buffy grey bands.

G. Greyer, with pure white spots and streaks: Lowe's grey peacock pheasant (*bailyi*).

GG. Browner, with more buffy spots and streaks.

H. More greyish, the spots more whitish: Himalayan grey peacock pheasant (*bakeri*).

HH. More brownish, the spots more buffy: Burmese grey peacock pheasant (*bicalcaratum*).

CC. Ventral plumage black; side of breast iridescent green; tail with dark terminal spotting or subterminal band.

D. Mantle and wing having numerous ocelli; crest rudimentary: Bornean peacock pheasant.

DD. Mantle and wing-coverts uniformly iridescent green; distinctly crested: Palawan peacock pheasant.

BB. Lacking both spurs and crests; mantle iridescence reduced or lacking (females).

C. Outer tail feathers with definite ocelli on both webs; mantle ocelli often somewhat iridescent.

D. Posterior margins of dorsal ocelli rounded, with a loose white fringe; body generally greyer: grey peacock pheasant.

DD. Posterior margins of dorsal ocelli bordered with chevrons or arrow-like margins; body generally browner: Germain's peacock pheasant.



CC. Outer tail feathers with definite ocelli only on outer webs; mantle spotting non-iridescent.

D. Back feathers and upper tail-coverts lacking ocelli: Palawan peacock pheasant.

DD. Back feathers and upper tail-coverts with blackish ocelli present.

E. Breast vermiculated grey, ocelli usually with whitish anterior spots: Bornean peacock pheasant.

EE. Breast vermiculated brown, ocelli usually without whitish anterior spots: Malayan peacock pheasant.

## BRONZE-TAILED PHEASANT

*Polyplectron chalcurem* (Lesson) 1831

Other vernacular names: Sumatran peacock pheasant; eperonnier à queue bronzée (French); Bronzeschwanzfasan (German); karo-karo, loekei (Sumatra).

### *Distribution of species*

The island of Sumatra, in mountain forests between 1500 and 4000 ft. See map 19.

### *Distribution of subspecies*

*Polyplectron chalcurem chalcurem* Lesson: south Sumatran bronze-tailed pheasant. Mountains of Sumatra south of the equator, intergrading with *scutulum*.

*Polyplectron chalcurem scutulum* Chasen and Hoogerwerf: north Sumatran bronze-tailed pheasant. Mountains of Sumatra north of the equator, intergrading with *chalcurem*.

### Measurements

Delacour (1977) reported that males of *chalcurem* have wing lengths of 162–190 mm, and tail lengths of 260–380 mm, while females have wing lengths of 150–162 mm and tail lengths of 180–220 mm. Two males weighed 425 and 590 g, and four females weighed 238–269 g, averaging 251 g (D. Rimlinger, *in litt.*). The eggs average  $49 \times 36$  g, and have an estimated fresh weight of 35 g.

### Description (after Delacour 1977)

#### Male

Head and neck earthy brown, the throat spotted with dirty white; upperparts chestnut-brown, the



**Map 19.** Distribution of north Sumatran (N) and south Sumatran (S) races of bronze-tailed peacock pheasant, and of Bornean (B), Malayan (M), and Palawan (P) peacock pheasants.

feathers irregularly and narrowly barred with dull black; the primaries uniform dark brown; long upper tail-coverts like the back; rectrices chestnut with black bars that become broad and metallic purplish violet some distance from the base on the outer webs, farther up on the inner webs, then fuse to form solid patches near the tip, which is always dark brown spotted with greyish buff; these metallic bars and patches represent the ocelli of other species; underparts dark brown with faint blackish barring; under tail-coverts clearly barred. Iris dark brown, bill and legs greyish black.

#### *Female*

Similar to the male, but smaller, without spurs, and a less iridescent tail.

#### *First-year male*

Similar, but the tail is shorter and the metallic patches often reach the top of the rectrices; spurs only rudimentary.

#### *Juvenile*

Like the adults, but slightly lighter and redder, and with little or no blue in the tail.

### **Identification**

#### *In the field (14–22 in.)*

The limited Sumatran range of this species makes it unlikely to be confused with any other species. It is found in heavy cover, often in very mountainous country. Other than some twittering *pitt* calls, almost nothing has been reported of the species' vocalizations. The generally chestnut-brown colour of the plumage, lacking in definite ocelli, together with a pointed tail, should serve for field identification.

#### *In the hand*

This is the only peacock pheasant that completely lacks ocelli on the tail feathers, and iridescence is limited to indefinite barring and patches in males. In both sexes the facial area is almost completely feathered, with no obvious bare area of skin around the eyes.

### **Geographic variation**

Geographic variation in this species is limited and probably is clinal. Birds from northern Sumatra (*scutulatum*) have their upperparts more strongly marked, with the black barring wider and more distinct.

### **Ecology**

#### *Habitats and population densities*

This little-studied species is found in the montane forests of Sumatra, between about 500 and 4000 ft elevation, where it has not yet been studied in detail.

#### *Competitors and predators*

These are among the smallest of the true pheasants, and are probably dominated by any others that they might encounter in the region. However, nothing is known of the species' competitors or predators.

### **General biology**

#### *Food and foraging behaviour*

Beebe (1918–1922) reported that examination of several crops indicate that this species eats small fruits and insects, but did not provide further specifics. In captivity it eats the normal pheasant diet, in addition to peanuts, chopped fruits, seeds, mealworms, and the like (Howman 1979).

#### *Movements or migrations*

Nothing has been reported on this subject, but it is very unlikely that movements of any significance occur, given the equatorial distribution of the species.

#### *Daily activities and sociality*

Nothing has been noted of this in the wild, but in captivity the birds are highly secretive, spending most of their time under cover, or on their perches. They are extremely quiet birds, and probably occur in pairs or at most in family groups under natural conditions.

### **Social behaviour**

#### *Mating system and territoriality*

There is no information on this subject in wild birds. Judging from the low incidence of sexual dimorphism and the extremely simple male courtship display, it would seem highly possible that only a limited degree of non-monogamous mating is likely. No crowing or other territorial advertisement behaviour has yet been reported for the birds.

#### *Voice and display*

Males are said to have a loud and rather harsh call (Rutgers and Norris 1970), although Delacour (1977) stated that he never heard the birds utter anything more than a twittering and repeated *pitt* call. He stated that the male's display is laterally oriented,



with the tail partially spread in a vertical manner. Roles (1981) is more precise, saying that the male circles the hen, with the tail held horizontally, but with the feathers angled into a nearly vertical plane, much like the display of a golden pheasant.

Mr Kenneth Fink and I observed display several times by a single male at the San Diego Zoo, and on each occasion the male would approach the female (who was obscured by heavy vegetation from my sight), stop, flap its wings momentarily, and then lower its nearer wing directly downward, with the primaries of that wing scraping the ground in front of its feet, and freeze (Fig. 34). The tail was not raised or tilted, and the only apparent vocalization was a hissing sound, with a click at the end that was probably made with the beak. This hiss is somewhat similar to that made by a male golden pheasant. It was impossible to see what, if any, response was made by the female. Interestingly, however, the male performed its display in almost precisely the same location each time I saw it, in a manner that reminded me of a similar kind of localized activity observed in Rothschild's peacock pheasant.

Recent observations on captive birds by Davison (in press, c) are more complete than these, and suggest that the major male posturing is a lateral orientation, with a lowering of the nearer wing and a slight tail-tilting. Other observed male displays were a ruffling of the head and anterior feathers, a crouching run toward the female, head-bobbing (also performed by females), and a 'shuffle' that usually occurred between the wing-flap, lateral orientation sequence described above. Copulation occurred without elaborate associated display.

## Reproductive biology

### *Breeding season and nesting*

There is no information on this in the wild. In captivity, the birds lay two-egg clutches as do most peacock pheasants. In one case noted by Delacour (1977) this occurred in an elevated basket high on an aviary wall, and after the eggs were removed the female laid again less than a month later, and a third time during the same season.

### *Incubation and brooding*

In captivity it has been found that the incubation period of this species (under a bantam hen) is 22 days (Delacour 1977). So far as is known, the male plays no role in reproduction following fertilization.

### *Growth and development of the young*

Chicks of this species have been reported as fairly easily raised, requiring a mixture of the usual pheasant-rearing foods as well as live insects such as

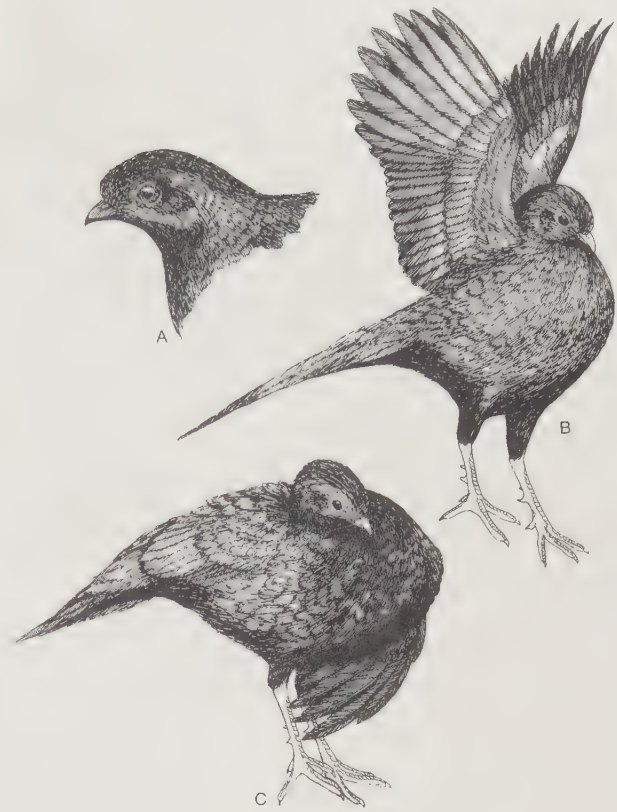


Fig. 34. Postures of male bronze-tailed pheasant, including normal posture (A), and wing-flap, lateral 'freezing' sequence (B and C). After photographs by the author.

ants, ant pupae, and mealworms. They reportedly rarely eat green materials. They attain their full adult plumage in the first year.

## Evolutionary history and relationships

There can be little doubt that this is the most generalized of the peacock pheasants, nor that its nearest relative is *inopinatum*. The genus *Chalcurus* has in the past often been maintained for these two species; indeed Beebe (1918–1922) listed eight characteristics of plumage and morphology by which *Polyplectron* (*sensu stricto*) differs from *Chalcurus*, and in which the former represents a more specialized condition. However, the entire group is fairly easily characterized and I see no real advantage in separating the two most generalized forms from the remainder.

## Status and conservation outlook

This species is probably little bothered by humans for either its flesh or feathers, and its future certainly depends on the preservation of some areas of

montane forest in Sumatra. So long as they continue to exist there would seem little reason to be concerned about its status.

### ROTHSCHILD'S PEACOCK PHEASANT

*Polyplectron inopinatum* (Rothschild) 1903

Other vernacular names: Malayan bronze-tailed pheasant, mountain pheasant, mirror pheasant; eperonnier de Rothschild (French); Spiegel-Bronzeschwanzfasan (German).

#### *Distribution of species*

Mountains of the Malay Peninsula from Bukit Fraser and the Semang-ko Pass, along the main range to Gunong Uku Kali and Gunong Mengjuang Lebar; Gunong Tahan and Gunong Benom in Pahang. In rugged and wooded mountain habitats above 3500 ft. See map 20.

#### *Distribution of subspecies*

None recognized.

#### Measurements

Delacour (1977) reported that males have wing lengths of 230–255 mm, and tail lengths of 320–400 mm, while females have wing lengths of 175–190 mm, and tail lengths of 220–275 mm. No weights are available. Eggs average  $53.2 \times 37.0$  (51–57  $\times$  36–38) mm. (Vern Denton, personal communication), and have an estimated weight of 40.2 g.

#### Description (modified from Delacour 1977)

##### *Male*

Head uncrested; neck, face, and throat dark grey, finely streaked with pale grey and spotted or striped with white, especially on the throat and face; a very short ruff of fluffy feathers of the same colour on the



**Map 20.** Distribution of Burmese (B), Ghigi's (Gh), Hainan (H), Himalayan (Hi) and Lowe's (L) races of grey (Gr) peacock pheasant, and of Germain's (G) and Rothschild's (R) peacock pheasants.



hindneck and upper back; mantle, wings, and back chestnut with wavy black lines, the base of the feathers greyish, the tip with a small metallic blue ocellus surrounded by a black line and a wider reddish one, and a buffy white spot at the base; primaries plain dull black; upper tail-coverts coarsely mottled chestnut and black; the outer ones with large adjoining blue to greenish spots on both webs; tail of twenty rectrices, pointed as in *chalcureum*, somewhat graduated, black spotted with buff, the central pair without metallic spot, the next pair with a reduced one on the inner web, the others with green spots on both webs, smaller on the inner one; these spots tend to become round and ocellus-like, thus transitional between the condition in *chalcureum* and the ocelli of the other species; underparts greyish black, minutely spotted and streaked with pale grey; thighs and under tail-coverts tinged with brown. Iris brown, bill and legs grey.

#### *Female*

Similar to the male, but much smaller; the ocelli of the upperparts replaced by dull black spots; tail of eighteen rectrices, shorter and less graduated, the spotting and mottling redder and less regular.

#### *First-year male*

Smaller and less bright.

#### *Juvenile*

Similar to the female.

### Identification

#### *In the field (18–26 in.)*

This species occurs on the Malayan peninsula, where the Malayan peacock pheasant also occurs, but the latter species is a lowland form, unlikely to be found in the high montane habitats of this species. Further, the present species lacks a crest, and has a face that is fully feathered. The face and head are somewhat more greyish than is the rest of the upper plumage, which tends to be chestnut-toned. In both sexes the upperparts are dotted with small, dark ocelli, but those on the tail feathers are limited to the lateral feathers, where they are large and somewhat indefinite. The few reported vocalizations are a low, chuckling and conversational *chack* call, and a quiet, burbling, descending whistle.

#### *In the hand*

Easily identified as a peacock pheasant on the basis of the small ocelli on the mantle, this species is the only one that both lacks a crest and extensive bare facial skin, but nonetheless has distinct ocelli present on the upperparts.

### Ecology

#### *Habitats and population densities*

Very little is known of the ecology of this species, but it is said to inhabit the ground storey of montane forests above 3200 ft on the Malayan Peninsula (Medway and Wells 1976). Davison and Scriven (in press) found the species only above 900 m in tall, lower montane forests, and noted that it has once been reported as high as 1800 m in upper montane forests. All the sites in which this species was encountered were steep, with exposed bedrock in some places, and with some bamboo and stemless climbing palms present. These sites also had thin, mor soils developed over deeper granite-derived materials, but the species has also been reported from sandstone-based soils. The birds were always found on or close to ridge crests.

There are no available estimates of population densities.

#### *Competitors and predators*

No other peacock pheasant occurs at the altitude of this one, and it seems unlikely that it would compete with fireback pheasants or with either argus species. Nothing is known with certainty of its predators, although Beebe (1918–1922) judged that civet cats might be an ever-present menace.

### General biology

#### *Food and foraging behaviour*

There is no direct information on this from wild birds except for the crop contents of a single male, reported as spiders, white ants, several grubs, and some unidentified creatures. The birds have also been reported to eat insects, millipedes, and the fruit of a creeping rattan palm (*Calamus*), according to Beebe. He observed one group of birds scratching in rain-washed gravel, and one of the birds plucking blossoms from a clump of flowers.

#### *Movements or migrations*

There is no information on this, but significant movements are highly unlikely, given the limited geographic and altitudinal ranges of the birds.

#### *Daily activities and sociality*

Beebe did not observe these birds enough to establish their relative sociality or daily activity patterns; indeed a sighting of five birds (three adults and two young) provided his only extended view of the species. Davison and Scriven (in press) stated that the birds are difficult to census because of the absence of any loud calls. Beebe judged that they probably roost in trees free of vines and parasitic plants, and twice

he saw single birds apparently sunning themselves on the bare dead limbs of tall trees. He also observed several places where deep holes had been scratched in earth mould along the sides of the upper slopes of shady ravines, especially on their eastern and north-eastern slopes.

### Social behaviour

#### *Mating system and territoriality*

Nothing is known for certain of this species' mating system, although its very limited sexual dimorphism might suggest monogamy. Ridley (in press) believed that the males of most peacock pheasants desert their mates during or after egg-laying, and they may remate with a different female, in sequential polygyny. Beebe's observation of three adults attending two young is interesting; unfortunately he was unable to determine the sexual composition of the adults, although at least one of these was an adult male. Vern Denton (personal communication) found no evidence of polygyny in his captive birds when such opportunities were provided.

If the males are territorial they seem to lack any loud advertisement or challenging calls; as none has yet been described.

#### *Voice and display*

Beebe (1918–1922) caught a glimpse of display in a wild male, which 'stepped into a spot of full sunlight' and momentarily fluffed its plumage, as the tail was spread and slanted, the right wing was raised, and the other was lowered. This posture was held only momentarily, and Beebe judged it might be the beginning phase of male display.

I was able to observe very briefly display in a pair of captive birds in the collection of Mr Vern Denton, Livermore, California, on 22 February 1983. In this case, the male walked several times in a circular route around a large shrub in the pen, and each time as he emerged into the female's full view he stopped and assumed a strong lateral display posture (Fig. 35), with the tail tilted and spread, the nearer wing lowered, and the farther one raised as the bird stood motionless for a second or two. No calls were audible nor did I observe any tidbitting behaviour. What struck me as especially interesting was the apparent use of his sudden appearance from behind the shrub as a kind of 'dramatic entrance'. I did not observe any wing-flapping, nor hear any calling on the part of either sex. The female seemed to ignore the entire performance. Denton (1978) stated that the male displays he has observed have been 'lateral snap postures' rather than full frontal display as typical of the grey peacock pheasant. He also informed me (*in litt.*) that although the male usually exhibits a 'partial'

lateral display, when he is actively preparing to breed he has a 'full' lateral display. However, an F<sub>1</sub> hybrid with a grey peacock performed the frontal display, while a backcross male hybrid to the Rothschild's tended to perform laterally.

Copulatory behaviour remains undescribed.

### Reproductive biology

#### *Breeding season and nesting*

Almost nothing is known of this in the wild, but Beebe (1918–1922) was shown an old nest in a rocky defile at about 3200 ft elevation. The nest site was where two large trees had fallen parallel to one another, and was close to the hollow formed by the roots tearing out of the ground. Two eggs had been present. He judged that late January is the breeding season in Malaya, since a small chick had been collected in late February.

Denton (1978) stated that a captive female laid her first eggs in March, somewhat later than did his grey peacock pheasants but earlier than the Palawans and about the same time as Germain's. After laying one clutch of two eggs she would wait about two weeks before laying another, but the interval was shorter at the start of the breeding season than toward the end. He noted that his wild-caught female laid three eggs in 1970, eight in 1971, and several in 1972, when the female died.

#### *Incubation and brooding*

Apparently two-egg clutches are typical of this species, with the second egg laid two days after the first one. The incubation period is 19–21 days, usually the latter.

#### *Growth and development of the young*

Denton (1978) reported that he was able to raise chicks of this species (or hybrids with grey peacock pheasants) by keeping a bantam chick with them, which would teach them to eat and drink. Egg yolk and chick feed tends to stick to the beak of the bantam chick, which the peacock pheasant chicks then peck at, as they would at their mother's beak. He observed that a group of F<sub>1</sub> hybrids with grey peacock pheasants were almost successful in producing young when only a year old, laying six eggs and hatching two young that died within a week. In birds that more closely approximated pure Rothschild's the period to maturity approached two years.

### Evolutionary history and relationships

This is an extremely interesting species, which in nearly all respects seems transitional between the





Fig. 35. Postures of male Rothschild's peacock pheasant, including lateral display to female from farther (A) and nearer (B) sides, and crest erection (C). After photographs by the author.

bronze-tailed pheasant and the more typical *Polyplectron* species. This is true both of the relative development of ocelli on the tail and back, and also of male posturing, which retains the lateral aspects of the bronze-tailed pheasant display, but begins to exhibit the use of dorsal ocelli in display as well, and provides the behavioural precursor for the more fully frontal orientation typical of grey peacock pheasants and their near relatives. This intermediacy in plumage and behaviour favours the view that all peacock pheasants should be included in the single genus *Polyplectron*, rather than recognizing

the more generalized forms as *Chalcurus*. This view is supported by Denton's (1978) finding that hybrids between Rothschild's and grey peacocks pheasants are fully fertile.

#### Status and conservation outlook

Although there is still very little information, Davison and Scriven (in press) judged that this species is still locally common in its very restricted range on the Malayan Peninsula.

## GREY PEACOCK PHEASANT

*Polyplectron bicalcaratum* (Linnaeus) 1758

Other vernacular names: iris peacock pheasant, chinquis pheasant; eperonniers chinquis (French); Nord-Spiegelpfau (German); tshinquis, chin-tchien-khi (Chinese, from which chinquis derives).

*Distribution of species*

Sikkim east through Burma, and south-east to Indochina, plus the island of Hainan. Occurs in dense evergreen and semi-evergreen forests to 4000 ft, rarely higher. See map 20.

*Distribution of subspecies*

*Polyplectron bicalcaratum bakeri* P. R. Lowe: Himalayan grey peacock pheasant. Sikkim, Bhutan and western Assam south to Manipur and Sylhet, intergrading with nominate *bicalcaratum*.

*Polyplectron bicalcaratum bailyi* P. R. Lowe: Lowe's grey peacock pheasant. Distribution unknown, but probably western Assam or parts of the eastern Himalayas.

*Polyplectron bicalcaratum bicalcaratum* (Linnaeus): Burmese grey peacock pheasant. Chittagong, Chin and Kachin Hills, north-east Assam, Burma east to western Tonkin, south to southern Tenasserim, south-west Thailand and central Laos.

*Polyplectron bicalcaratum ghigii* Delacour and Jabouille: Ghigi's grey peacock pheasant. Central and northern Vietnam north of lat. 16° N and eastern Tonkin, intergrading with *bicalcaratum* in central Laos.

*Polyplectron bicalcaratum katsumatae* Rothschild: Hainan grey peacock pheasant. The island of Hainan. Considered a separate species by Beebe (1918–1922).

**Measurements**

Delacour (1977) reported that males of *bakeri* have wing lengths of 210–240 mm, and tail lengths of 350–400 mm, while females have wing lengths of 175–215 mm and tail lengths of 230–255 mm. The race *katsumatae* is smaller, with males having wing lengths of 195–198 mm, and tail lengths of 285–300 mm, while females have wing lengths of 160–165 mm and tail lengths of 170–190 mm. Cheng *et al.* (1978) reported the weights of four male *bicalcaratum* as 660–710 g, and of two females as 460 and 500 g, while a single male of *katsumatae* weighed 456 g. Males of *bakeri* range from about 568 to 910 g (Ali and Ripley 1978). The eggs of *bakeri* average about 48 × 37.5 mm, and have an estimated fresh weight of 37.3 g.

**Description (after Baker 1928)**

*Male (of bicalcaratum)*

Whole upper plumage buffy-brown to greyish, the hairy feathers of the head and neck finely vermiculated with buffy white or buff, and the rest of the upper surface with pale buff spots, which tend to collect and form indefinite bars on the lower back, rump and upper tail-coverts; the feathers of the mantle, the wing-coverts, except the outermost lesser coverts, and the inner secondaries have violet green-blue ocelli at their tips, each ocellus surrounded with a narrow brownish black band and a second broader one of white; similar ocelli occur on the tail feathers in pairs near the tips; these ocelli are larger than those on the mantle, oval in shape and greener in colour, with an outer ring of pale brown rather than white; chin, throat and sometimes foreneck pale buff; remainder of lower plumage like the back but with the bars better defined on the breast and flanks; on the under surface of the tail the ocelli appear as blackish blots. Iris white or pearl-grey, facial skin yellowish flesh, sometimes more reddish, bill black at the tip and on the culmen, otherwise creamy flesh, legs and feet dark slaty or greenish-plumbeous to blackish.

*Female*

Similar to the male but duller and with the ocelli less brilliant, the rings of black and white being replaced by broken bars; the ocelli on the shorter tail-feathers are lacking; the pale buff or white on the throat is more extensive, the crest more developed and more feathery. Very old females are sometimes almost indistinguishable from males except for their shorter tails. Iris brown, grey-brown, or grey; bare skin dull fleshy, legs and feet paler than in males.

*Immature*

Resembles the female. Adult plumage is usually attained the first year. Young males are smaller and duller than adults, with the whole plumage irregularly vermiculated with white, pale grey or buff, and the ocelli are irregular and blackish blue. The crest, ruff and tail are short, and the tarsi lack spurs (Delacour 1977).

**Identification**

*In the field* (22–30 in.)

This peacock pheasant is fairly widespread in south-east Asia, occurring in forested habitats up to about 6000 ft. The birds are generally greyish (males) or brownish (females), with whitish throats and dark



ocelli on the back and wings. The male has a bushy crest that is often erected anteriorly in front of the eyes, and the tail is generally rounded, with large iridescent ocelli. The species' calls include a loud, whistled *trew-tree*' or *taa-pwi*'. The male also utters a harsh and repeated *putta* call that begins slowly and becomes faster, and a sort of 'warbling song' consisting of little chirps that rise and fall, and may continue for several minutes. Except on the Malayan peninsula, where it is replaced by the Rothschild's peacock pheasant, this species is not believed to be in contact with any other peacock pheasants.

#### *In the hand*

The grey peacock pheasant is fairly readily identified by the distinctly greyish overall plumage colour of males, interrupted by numerous iridescent ocelli, and its short, bushy forehead crest and yellowish facial skin. Males of the very similar Germain's peacock pheasant are generally more blackish grey, and have reddish facial skin. Females are extremely similar, but female Germain's have more intensely coloured facial skin, are more melanistic throughout, and have more distinctly triangular ocelli than do females of the grey peacock pheasant.

#### **Geographic variation**

This is the most widely and variable of the peacock pheasants, and exhibits variation in both colour and size. The smallest and brownest of the races is the easternmost (*katsumatae*), which is isolated on the island of Hainan. The mainland forms also show a clinal trend from grey in the west to brownish in the east (approaching *germaini*, which can be considered the south-easternmost representative of this series), but show little or no size variation. The short crest and ruff of *katsumatae*, as well as its relatively small size, also suggest an intermediate link with *germaini*.

#### **Ecology**

##### *Habitats and population densities*

In general, this is a bird of the tropical lowland forests, occurring within the Indian region from the plains and foothills up to about 2000 ft, and rarely to as high as 6000 ft. The birds are especially common in thick cover along streamside banks, and in dense evergreen forests, tangled scrub and secondary growth, or mixed bamboo and thick scrub. An ideal habitat consists of the heavy undergrowth and small-tree forest developing about three or four years after a hill rice-field has been left uncultivated.

They also are associated with ravines in very broken country, where rock outcrops and thick bush cover occur amidst virgin forest. Nearly everywhere they occur during the breeding season there is likely to be water nearby (Baker 1935).

There are no estimates of population densities. Beebe (1918–1922) thought that the birds were locally fairly common, and noted observing thirteen in a walk of four or five miles, a substantial number in view of the secretive behaviour of these pheasants.

##### *Competitors and predators*

There does not appear to be any specific information on these subjects.

#### **General biology**

##### *Food and foraging behaviour*

Beebe (1918–1922) noted that the birds which he shot near Kachin villages invariably had rice in their crops, as well as small insects. He noted too that they seemed to be especially fond of a small fruit resembling a miniature tomato, that he was evidently unable to identify. According to Ali and Ripley (1978) the birds eat grain, berries, seeds, wild figs, insects, grubs, snails, and other small animals, with termites especially relished, and bamboo seeds eaten when they are available. Baker (1930) noted a preference for various figs, wild plums, ber fruit (*Zizyphus*), and bamboo seeds. He considered the birds omnivorous, often eating invertebrates, and sometimes also the young shoots of various green crops.

When foraging, the movements of the birds are slow, methodical, and very secretive, scratching for food in a quiet and restrained manner, moving very quietly through the heavy undergrowth around them, and slinking under obstructions rather than hopping over them (Baker 1930).

##### *Movements or migrations*

There is no evidence of significant movements in this species.

##### *Daily activities and sociality*

These are not social birds, and instead seem to occur in pairs or at most small groups throughout the year. Once the young have left their parents they are said never to occur in flocks (Baker 1930).

Nothing seems to have been noted of their roosting sites. Beebe (1918–1922) stated that early in the morning and late in the afternoon the male perches on a branch, not its roost, to crow, and that this occurs nearly every month of the year.

## Social behaviour

### *Mating system and territoriality*

Baker (1930) doubted whether this species is polygynous in the wild, but rather thought that each pair has a well-defined territory from which others are excluded during the breeding season. He thought that the pair bond persisted all year, and noted that whenever a bird of one sex is shot or trapped another of the other sex is almost always to be found close at hand. Beebe (1918–1922) also noted that pairs have been recorded in every month, and that many seem to be paired all year. However, there is no evidence of the male assisting in the caring for the young, and Ridley (in press) believed that in most species of *Polyplectron* the pair bond is terminated at about the time of incubation.

Quite certainly the males perform self-advertising displays by crowing, not only during the breeding season but also throughout much of the year (Beebe 1918–1922).

### *Voice and display*

The male's crowing call is unusually loud and penetrating; Beebe (1918–1922) described it as *phee-hoo!*. It is repeated at intervals varying from every ten or fifteen seconds to every minute or more. He considered this to be a challenge call to other males and an attraction call to females. Baker (1930) called it a loud, chuckling, laughing note, usually uttered from an elevated location such as a stump or a low tree branch, and sometimes followed by soft wing-flapping sounds. It has also been described as a musical whistle of two syllables (Wayre 1969). Another major call is a series of from six to twelve croaking calls uttered in rapid succession, and sounding more like the noise made by a frog than a bird. This has been variously described as sounding like *wak-wak-wak*, *qua-qua-qua*, and *ok-kok-kok*, etc. It is often uttered after some loud noise, such as thunder or a gunshot, and may serve as an alarm note, when it tends to be given as a rapid cackle.

The postural displays of this species are especially interesting, and have been described in detail by various authorities (Pocock 1911; Beebe 1918–1922). Pocock has pointed out that although both lateral and frontal displays occur, the former is rather different from the usual lateral display of pheasants. The nearer wing is scarcely lowered, while the farther one is strongly raised, spread to its fullest extent, and is pointed forward so that the tip is stretched well in front of the head, which is somewhat retracted. The tail is also fully spread and twisted toward the female, forming a nearly vertical fan, and thus maximally exposing the ocelli of the tail as well as those of the upper wing surface to the

female's view. The crown feathers are raised and directed forward towards the front of the beak. This display is apparently silent.

The second, and more typical display, is usually preceded by a melodious chirping whistle, which serves as a food-attraction call to the female, who typically comes running toward the male. The male then faces the hen, raises and spreads his tail and wings, and tilts his body up to the vertical, while lowering his head and breast to the ground. The bird thus forms a remarkable visual pattern of a somewhat triangular or rounded brown feathered shield, with transverse curving bands of iridescent ocelli (Figure 36). As Pocock pointed out, this posture and visual pattern closely approaches the complex and remarkable frontal display of the argus pheasant in which the wing feathers are similarly brought up to meet in the middle above the back, hiding not only the plain-coloured back but also even most of the head, which is largely obscured by the primaries of one wing. In this way, the grey peacock pheasant provides a fine behavioural link between the lateral displays of the Rothschild's peacock pheasant and the more clearly frontal display of the great argus and the true peacocks. Beebe (1918–1922) makes the further point that during the frontal display the iridescent coverts extend out beyond the closed primaries to a degree that would not occur during normal wing-spreading, and thus further maximize the visual impact of the display. Even the tail is spread out to a point so that the outermost feathers may be brought to within an inch or two of the ground, forming a complete half-circle of patterned feathers. The female may respond to this display with a similar but less fully developed posture of her own, but much more commonly seems to pay no attention to it. Copulatory behaviour has not been specifically described, but probably follows such a display by the male. Stokes and Williams (1972) illustrated the tidbitting call sonographically; it consists of a very rapid series (about nine per second) of rather high-pitched notes.

## Reproductive biology

### *Breeding season and nesting*

In the Indian region, the breeding season is from March to June, but mainly occurs in April and May. The nest is usually made in a hollow, often at the foot of a clump of bamboo, or in thick bushes amongst jungle cover. The location is always in very dense jungle, and when placed among bamboos it is always of mixed bamboo and scrub, rather than in thin and open bamboo forest. A favoured site is in tangled secondary growth that is nearly impen-





**Fig. 36.** Postures of male grey peacock pheasant, including crest erection (A), frontal display (B), lateral display (C), and fronto-lateral display with tidbitting (D). After photographs by the author.

erable close to the ground, and almost invariably the nest will be located no more than a few hundred yards from a stream or pool (Baker 1930).

In captivity, the nesting season apparently extends from late February to the end of July, but peaks in late March and early April, according to Beebe (1918–1922). He stated that under these conditions the birds deposit their eggs every two days, and a female may produce from eight to 14 eggs in a single season. Flieg (1973) noted that from three to

six clutches were laid per season with an average interval of 21 days between clutches. Under captive conditions the clutch-size is invariably of only one or two eggs, and most but not all observations in the wild support the contention of a two-egg clutch. However, Baker (1930) was of the opinion that in the race *bakeri* clutches of three or four are not rare, and a few of five or six have even been reported. He was convinced that these large clutches were not the result of laying by more than one bird, although that would seem impossible to prove.

*Incubation and brooding*

Incubation is performed by the female alone, although Baker (1935) believed that the male remains close to the hen whilst she is sitting, but does not assist in incubation. The incubation period is about 21 days.

*Growth and development of the young*

The care of the young in this and probably the other species of *Polyplectron* is of special interest. The young follow the mother under the cover of her rather long tail, which is held low and somewhat spread. When the female finds a morsel of food she calls, and the chicks dart quickly out to obtain it, and as quickly return to the cover of their mother's tail. Furthermore, at least in their first few days, the young are fed directly from the mother's beak rather than being able to pick items up from the ground directly after hatching. Once the chicks have learned to feed for themselves they can catch insects with great success, and soon are able to leap into the air and even fly as an aid to their pursuit (Beebe, 1918–1922). Sexual maturity is attained during the first year (Flieg 1973).

**Evolutionary history and relationships**

I believe that this species, together with the very closely related *germaini*, represents a somewhat transitional form between the more generalized peacock pheasants represented by the bronze-tailed and Rothschild's, and the more specialized forms in the remainder of the genus. Beyond the superspecies complex of the grey and Germain's peacock pheasants, the Malayan and Bornean peacock pheasants are their probable nearest relatives, and the zoogeographic relationships among this group pose no problems in visualizing the speciation process.

**Status and conservation outlook**

This species thrives under conditions of secondary forest succession, and so is likely to remain relatively common indefinitely. It is highly vulnerable to snaring (Baker 1930; Beebe 1918–1922), but such would not seem to be a serious threat except very locally, and it is apparently not specifically hunted for either its feathers or its flesh. Deforestation provides a threat to this and other forest-dwellers in some areas; for example on Hainan Island there has been a loss of 72 per cent of the island's tropical forests since 1949 (Smil 1983).

**GERMAIN'S PEACOCK PHEASANT**

*Polyplectron germaini* Elliot 1866

Other vernacular names: Germain's pheasant; eperonnier de Germain (French); Ost-Spiegelpfau (German).

*Distribution of species*

Southern Vietnam north to Quinhon, in damp forests from sea level to 4000 ft. Also reported once from Thailand (Riley 1938) and also from Cambodia, although Delacour (1977) disputed this contention. See map 20.

*Distribution of subspecies*

None recognized. This form is sometimes considered a subspecies of *bicalcaratum* (Beebe, 1918–1922), but is here considered a full species, and part of the *bicalcaratum* superspecies complex.

**Measurements**

Delacour (1977) reported that males have wing lengths of 180–200 mm, and tail lengths of 250–320 mm, while females have wing lengths of 160–185 mm and tail lengths of 220–250 mm. One male weighed *c.* 510 g, while a female weighed *c.* 397 g (Stephen Wylie, personal communication). The eggs average 45 × 35 mm, and have an estimated fresh weight of 30.4 g.

**Description (after Delacour 1977)***Male*

No crest nor ruff; head, lower throat and neck black, finely mottled with greyish white; upper throat white; upperparts dark brown spotted with buff, the feathers of the mantle and wings with a large round terminal ocellus of violet blue with green reflections, surrounded by a black ring and a pale golden brown border; no ocelli on back or rump; primaries plain dull black; central pairs of tail-coverts lacking ocelli; the lateral feathers with one on each web; flat graduated tail of twenty rectrices, broad and rounded at the tip, with a large subterminal ocellus on each web, metallic green with black and pale grey borders; underparts black, irregularly barred with buff; abdomen black. Iris brown, bare facial skin red; bill and legs blackish brown.

*Female*

Slightly smaller and duller than the male; head and neck similar but rest of the plumage dark brown streaked and freckled with pale brownish grey, not spotted; ocelli on mantle and wings triangular,



metallic blue with a black base and a pale buff upper border; rectrices blackish irregularly and finely barred with pale buff; the green ocelli large but not well defined and lacking the pale border, those on the outer feathers merging into one large patch as in *inopinatum*. Soft parts as in the male.

#### *First-year male*

Like the adult, but the ocelli blackish and the spurs rudimentary; tail shorter.

#### *Juvenile*

Like the female, but with dull black ocelli.

### Identification

#### *In the field* (19–22 in.)

Limited to Vietnam, this species is the only peacock pheasant found in that area. Both sexes closely resemble the grey peacock pheasant but, in addition to being generally darker, the bare facial skin is distinctly reddish. Males utter a mating call that is a high-pitched *hwo-hwoit*, quickly repeated four to six times, and the alarm call is a loud and fast cackle. The birds are associated with humid forests up to about 4000 ft.

#### *In the hand*

The short, bushy crest, rounded tail with numerous ocelli, and the generally brown to brownish grey body colouration separate this species from all other peacock pheasants except the grey. Males of the Germain's are more intensely pigmented and more melanized in general than are males of that species, and their facial skin is red rather than yellow. Females are also very similar, but those of the Germain's have more reddish facial skin, their tail ocelli are better developed and have more distinct ocelli, they are less whitish on the throat, and the ocelli on the back and wing-coverts tend to be triangular in shape rather than rounded.

### Ecology

#### *Habitats and population densities*

The habitats of this species are apparently much like those of the grey peacock pheasant, but are less well described. The birds occur in damp jungles and other forested habitats from sea level up to about 4000 ft (Delacour 1977; Beebe 1918–1922).

There are no estimates of population densities.

#### *Competitors and predators*

No other species of *Polyplectron* occur within the range of this species, but it may compete to some

extent with red junglefowl and *Lophura* pheasants, which probably occupy similar forested habitats. Nothing has been written of possible predators.

### General biology

#### *Food and foraging behaviour*

There is no information on this, but probably this species is virtually identical to the grey peacock pheasant in these regards.

#### *Movements or migrations*

There is little reason to believe that any substantial movements occur in this subtropical species.

#### *Daily activities and sociality*

Like the grey peacock pheasant, this species is relatively non-gregarious, and apparently occurs as pairs or small family groups in a sedentary and extremely inconspicuous manner.

### Social behaviour

#### *Mating system and territoriality*

Most authorities, apparently basing their judgments on captive observations, suggest that this species is normally monogamous (Roles 1981; Rutgers and Norris 1970). However, there are reports of captive males being mated successfully to two mates simultaneously (Roles 1981).

Nothing is known of territoriality in the wild; like the grey peacock pheasant the males of this species utter a crowing call during the spring, but it is much harsher and more chuckling-like than that of the grey. In England, the calling period of the male extends until early June (Keith Howman, personal communication).

#### *Voice and display*

As just noted, the crowing call of this species is distinctively loud and harsh, lacking the whistling quality typical of the grey peacock pheasant.

According to Keith Howman (personal communication), the Germain's male displays less intensively than does the male grey. He picks up food in the tidbitting display, then tends to retreat as the female approaches, performing a display that is somewhat intermediate between a lateral and frontal posture, with the tail not tilted so strongly upwards as in the grey. Wayre (1969) stated that the male has both a frontal and lateral display, and that his call (perhaps the tidbitting call) is a high-pitched musical whistle of three syllables, repeated four to six times. Delacour (1977) said that the 'love-note' was a repeated and high-pitched *hwo-hwoit*. Roles (1981) stated

that after a preliminary strutting and stalking around the hen while attracting her attention with a tidbit, he launches into a frontal display. Photographs that I have seen, taken by Lincoln Allen, suggest a frontal display posture quite similar to that of the grey (Fig. 37), but one that is perhaps more strongly directed laterally, and has less wing-spreading and tail-fanning than in the grey. Furthermore, the male lacks the crest of feathers that in the grey is brought forward above the beak. Copulatory behaviour is undescribed.

### Reproductive biology

#### *Breeding season and nesting*

The breeding season under natural conditions is said to be very extended, the birds breeding almost throughout the year (Delacour 1977). In captivity (in Florida), the birds begin laying about mid-February, slightly later than the grey peacock pheasants but earlier than Palawan peacock pheasants. Under those conditions the females lay from three to six one- or two-egg clutches, the intervals between suc-



Fig. 37. Postures of male Germain's peacock pheasant, including normal posture (A, tidbitting (B), and full fronto-lateral display (C). After photographs by Lincoln Allen.



cessive clutches averaging 21 days, as in the other two species just mentioned (Flieg 1973). Beebe (1918–1922) reported that four layings totalling eight eggs are the maximum to be expected from a hen during a single laying season. Nest sites in the wild are undescribed, but are likely to be essentially the same as described for the grey peacock pheasant.

#### *Incubation and brooding*

The incubation period is the same average length, 21 days, as in the grey peacock pheasant.

#### *Growth and development of the young*

Apparently the development of the young follows a very similar pattern to that of the grey peacock pheasant and avicultural techniques for raising them in captivity are essentially the same (Flieg 1973). The chicks are extremely delicate, and are almost exclusively insectivorous. If not fed by the mother or foster mother from the bill, they must be hand-fed using forceps or other device until they have learned to pick up food for themselves, which they usually do in a few days (Rutgers and Norris 1970). Like the grey peacock pheasant the birds attain full adult plumage and apparently also sexual maturity in their first year, although it seems probable that fertility would improve in the second year. Like the other peacock pheasants these birds tend to be long-lived, but are relatively sensitive to cold.

#### **Evolutionary history and relationships**

This is obviously a very close relative of the grey peacock pheasant, and indeed Beebe (1918–1922) concluded that they should be considered as only subspecifically distinct. Lowe (1925) strongly criticized this position, and said that the specimens that Beebe had based his conclusions on were not typical Germain's, and that indeed his plate of '*germaini*' was in fact of an undescribed form of the grey peacock pheasant, which he named *bailyi*. Examination of museum specimens is not convincing, but there seem to be sufficient differences in the voice and displays of live birds to warrant calling this a separate species, although its allopatric range makes any final taxonomic conclusion rather subjective. The two forms have often been hybridized in captivity (Delacour 1977).

#### **Status and conservation outlook**

Although the part of the world to which this species is native has undergone great ecological changes resulting from warfare, it seems likely that the species' ability to utilize dense second-growth following defoliation, deforestation, or logging might have

allowed it to survive fairly well. However, no real information is available on its current status.

#### **MALAYAN PEACOCK PHEASANT**

*Polyplectron malacense* (Scopoli) 1786

Other vernacular names: crested peacock pheasant; eperonnier de Hardwicke, eperonnier Malais (French); Malaia-Spiegelpfau (German); kuan, kuang (Malaya).

#### *Distribution of species*

Malay Peninsula, north to south Tenasserim (Tavoy) and south-west Thailand and Sumatra. Occurs below 3000 ft, in lowland and foothill forests. See map 19.

#### *Distribution of subspecies*

None recognized here. Delacour (1977) considered *schleiermacheri* to be a subspecies of this species, although both Beebe (1922) and Peters (1935) regarded the former as a distinct species, a position followed here.

#### **Measurements**

Delacour (1977) reported that males have wing lengths of 200–215 mm, and tail lengths of 240–250 mm, while females have wing lengths of 180–185 mm, and tail lengths of 180–190 mm. One male weighed *c.* 680 g (Riley 1938). The eggs average 46 × 37 mm, and have a fresh weight of 39–42 g (Bruning 1983).

#### **Description (after Delacour, 1977)**

##### *Adult male*

Long crest of disintegrated feathers, metallic blue-green streaked with pale grey as the base; forehead and sides of head finely streaked pale grey and black; ear-coverts purplish black; throat pale grey; ruff of disintegrated feathers pointed forwards on the nape and hind-neck; streaked pale grey and black with metallic violet tips; feathers of the mantle, wing-coverts, and tertiaries buffy brown spotted with black, with large blue ocelli surrounded with buff at the tip; secondaries, back, and rump rich buffy brown spotted with black; tail-coverts similar, the tips redder, and the longest with two large blue-green ocelli that are united on the shaft; tail shorter and much less graduated than in *bicalcaratum*, rectrices broad, almost square, and usually 22 in number, the four central pairs subequal in length, black with pale buff reticulations and one large sub-terminal green ocellus surrounded with black on the

outer web, the central pair only with an ocellus on each web; tips of rectrices rich buffy brown with black spots; throat whitish, middle of breast buff vermiculated with black; sides and rest of underparts finely vermiculated brown and black; primaries blackish brown. Iris bluish white; facial skin orange; feet and bill dark grey; the lower mandible yellowish flesh.

#### *Female*

Crest and ruff short, throat whitish; head, neck and underparts dull brown with very small black speckles; upperparts finely freckled buffy brown and black with dull black triangular ocelli on the mantle and wings; longest upper tail-coverts with two blue ocelli separated by the buff shaft, the tips buff spotted with black; rectrices similar, the central with two, and the others with one, subterminal ocellus. Iris brown; rest of soft parts as in the male.

#### *First-year male*

Like the female, but larger and brighter.

#### *Juvenile*

Like the female, with black spots on the wings.

### **Identification**

#### *In the field* (16–21 in.)

Limited to the Malayan Peninsula, the only other species likely to be encountered in this area is the Rothschild's peacock pheasant, which occurs at higher altitudes and lacks both a crest and orange facial skin. The Malayan peacock pheasant is generally limited to forested habitats under 1000 ft, and is usually found in heavy cover and as single birds or pairs. Males have a loud, cackling *kwock-kwock* call that is repeated frequently. Another call is a series of low clucks that descend in pitch and trail off. Females are virtually crestless, have shorter tails than do males, and have dark-coloured ocelli with buffy borders on their mantles and upper tail-coverts.

#### *In the hand*

The combination of orange facial skin, a long greenish blue crest that is backwardly oriented, and a generally brownish body colour that is studded with many iridescent ocelli on the back and tail serves to identify males of this species. Females have a considerably shorter (under 200 mm) tail, a pale grey throat, and conspicuous buffy borders to the dorsal ocelli, but otherwise are rather uniformly brown. They approach the female Palawan peacock pheasant in appearance, but the latter lacks the buff-bordered dorsal ocelli, and has a more extensive pale

grey area on the throat and sides of the face. Females are also very similar to those of the Bornean peacock pheasant but are less reddish, have a longer tail, and the upper tail-coverts have metallic ocelli, which are sometimes lacking in the Bornean form.

### **Ecology**

#### *Habitats and population densities*

In Malaya this species occurs in tall primary and secondary lowland dipterocarp forests, up to at least 180 m elevation. It occurs on level and gently sloping grounds, and seems to avoid steeply sloping sites. Breeding males are typically associated with areas having dense undergrowth, often near water, and with bankside vegetation rich in palms and various broad-leaved monocotyledons (Davison 1983b). Other authors have reported the species as occurring as high as about 1000 ft in Malaysia, and it even occurs up to 4000 ft in Cochinchina (King and Dickinson 1975).

Within an area of primary forest of 256 ha, Davison (1983b) found 26 male calling centres or presumed territories, providing an estimated density of a male per 9.8 ha. Another area had 13 calling centres in a 200 ha study plot, or a mean of a male per 15.4 ha.

#### *Competitors and predators*

There is no specific information on these subjects. Davison and Scriven (in press) found that this species is altitudinally separated from the Rothschild's peacock pheasant in peninsular Malaysia, and its interactions with the bronze-tailed pheasant on Sumatra are unstudied. It probably has only very limited contacts with the grey peacock pheasant at the extreme northern edge of its range.

### **General biology**

#### *Food and foraging behaviour*

Beebe (1918–1922) observed wild birds feeding on termites, as well as on fly larvae and pupae associated with decaying mollusc shells. Davison (1983b) suggested that food supplies affect the male's mating behaviour, with more intense activity in years of heavy fruiting of dipterocarp trees. Davison found that *Dracaena* and an unidentified climbing plant with sugary red berries were among the plants that accompanied dipterocarp fruiting, and were included in the diet of these pheasants. Nothing else seems to have been written on their food foraging under natural conditions, which seems to be done by pecking and scratching in the usual pheasant manner, according to Beebe.



### *Movements or migrations*

Apparently at least the males are quite localized on territories for much of the year, while females are seemingly more mobile (Davison 1983*b*). However, there is little reason to believe that any extensive movements occur in this species.

### *Daily activities and sociality*

Davison (1983*b*) noted that he made 28 sightings of solitary males, 17 of solitary females, and six of solitary birds of undetermined sex. He said this indicated habitual solitariness in both sexes. There were only four sightings of pairs, and two of these were made at display areas, while the other two were far from any known display area. Most sightings of both sexes were obtained during early morning hours, with the males appearing slightly later than the females, reflecting the earlier attendance by males on their display areas. Beebe (1918–1922) reported seeing the birds usually in pairs, with one group of five being the largest he ever observed.

## **Social behaviour**

### *Mating system and territoriality*

Although most calling has been reported during early morning hours, Davison (1983*b*) noted nocturnal calling during two different years when there were synchronous flowering and fruiting periods of dipterocarp trees. In such years a larger number of males were observed calling at his study sites, and there was a larger average number of display areas per calling male found. Of 92 such display areas observed, 88 were on old game trails or little-used man-made trails, and all were on level or gently sloping ground. The smallest of these was only 40 cm in diameter, while the largest was about  $1 \times 2$  m. These areas are kept clean by the males, although feathers and droppings accumulate on them. Any single display area might be used for as long as several months, and some were re-used in successive years.

### *Voice and display*

Advertising by males is performed by two types of calls. The first is a short two-noted whistle, with the second note longer and inflected upwardly. Davison found that short calls were given about a minute apart, for up to 30 min at a time, whilst males were alone at their display areas or elsewhere in the forest, either on the ground or while perched. The long call is a series of loud, grating notes, which initially have intervals of about 5 s between individual notes, but gradually the interval is reduced to about 1.5 s. Up to 117 such calls were heard in a series, which lasted up to 3 min. Males often replied to one

another's long calls, uttering either short calls or long calls of their own, and Davison believed that females might sometimes also utter long calls, but was unable to prove it. Males also uttered harsh cluck calls, often in long series of up to as many as 230 notes. While at their display sites males also spent some time preening, cleaning the ground surface, and feeding in the immediate vicinity (Davison 1983*b*).

Davison saw only two female visits to such calling males, and observed display at one of these. When the female approached, the male ceased calling and ruffled his head and neck feathers, performing ritualized preening, courtship feeding, and erect and lateral postures. A culminating frontal display, which has been observed in captive birds, was not seen at this time. Davison also observed agonistic display between two males at the edges of their territories. In this case the two males circled one another, calling at intervals. Each maintained a lateral posture, with the nearer wing lowered and the farther one raised over the back, with the secondaries and also the rectrices spread as to exhibit the ocelli. Intermittently the two would face one another, with tails spread and heads raised so as to expose a broad buffy stripe from the throat to the abdomen. The birds circled one another at increasing distances until they were about 40 m. apart, when the encounter was abandoned.

More detailed observations of display in captive birds have been provided by Stapel (1976), Bruning (1977), and Davison (1983*a*). Stapel and Davison have both noted that lateral as well as frontal display occurs, and although twittering tidbitting calls are uttered they are relatively quietly produced. Hissing occurs during lateral display, and feather-quivering sounds are also made. Feather-preening movements ('flagging' in Davison's terminology) are frequent, and Stapel noted that in one case the male performed a series of preening and dancing movements around the female with a silent lateral display 'identical in posture' to that of the Palawan peacock pheasant. During lateral display the crest feathers are extended anteriorly in front of the forehead and the dorsal feathers are strongly raised (Fig. 38). Davison (1983*a*) stated that during lateral display toward females the male will tilt his bill downward and variably raise the farther wing above the back, sometimes leaping into the air and hissing as he lands. During tidbitting the male may flap the farther wing or assume a frontal posture with the head lowered until the bill and breast touch the ground. The two wings are variably spread, and the head is twisted so as to expose only a single eye.

Behaviour associated with copulation is as yet undescribed.



**Fig. 38.** Postures of male Malayan peacock pheasant, including crest erection and tidbitting (A), lateral display (B), and fronto-lateral display (C). After photographs by the author (A) and John Bayliss (B), and a sketch by Esdaile Hudson (C).

## Reproductive biology

### *Breeding season and nesting*

The nesting season in the wild is rather uncertain, although Davison (1983*b*) reported two nests, located on 15 March and 2 April. Both were of single eggs, and one was on the top of a termite mound about 1.4 m above the surrounding ground, while the other was on leaf litter at ground level and amongst upper storey plants. Davison doubted the

authenticity of a supposed two-egg clutch reported by Baker (1928) from Thailand, which might well have come from a grey peacock pheasant. No other nests have been described from the wild.

Bruning (1977, 1983) has reported considerable success in breeding this species in captivity. He confirmed that a single-egg clutch is normal for this species, although he found that a female will recycle and lay another egg every three or four weeks. Under those circumstances a pair might breed for up to 10 months each year.



### *Incubation and brooding*

Bruning (1977, 1983) noted that the female of one pair of captive birds would incubate its single-egg clutch regularly, but that the 'parents' would care for and brood the chick, suggesting a greater role of the male in the nesting and brooding phase than might be considered typical. He reported a 22–23 day incubation period.

### *Growth and development of the young*

Bruning (1983) said that newly hatched young weigh from 24–28 g, compared with an average fresh egg weight of 40.4 g, or indicating a hatching weight of about 65 per cent of the egg's fresh weight. Chicks lose up to 4 g in their first day or so, but gain it back by the third or fourth day, and for the next two or three weeks gain about 2 to 4 g per day. By the end of the first month they average about 100 g, or four times their hatching weight, and double that weight during the second month. One female laid its first egg when only eight months old, and spurs begin to develop on males when they are 10–12 months of age. However, male chicks as young as three to eight months old may try to display to adults. Medway and Wells (1976) noted that one hand-reared chick initially displayed at 23 days, and that its tarsal spurs began to develop in its ninth month.

### **Evolutionary history and relationships**

There can be no doubt that the Malayan and Bornean peacock pheasants are extremely closely related; more will be said of that in the discussion of the latter species. Otherwise, this superspecies shows some strong behavioural and morphological similarities with the grey and Germain's peacock pheasants on the one hand (primarily in most of their plumage characteristics), while on the other a few resemblances to the Palawan peacock pheasant can also be perceived, such as in the intensely black underparts and slight tendency toward tail-banding in the Bornean peacock pheasant. The Malayan and Bornean peacock pheasants are unique in the family (if not in the entire Galliformes) in having one-egg clutches, and perhaps this is in part a reflection of their seemingly nearly year-long breeding potential. Davison (1983*b*) correlated relative breeding effort in the Malayan peacock pheasant with local food supplies, and thus it is possible that this species is operating in an environment with fewer suitable foods than would seem typical for pheasants in general, and a reduced clutch-size may be one reflection of this factor.

### **Status and conservation outlook**

This species is dependent upon primary forests and well developed secondary forests in lowland areas, which are fast being removed from the Malayan Peninsula and probably also Sumatra (Davison 1981*c*). Its long-term outlook must thus be considered as doubtful.

### **BORNEAN PEACOCK PHEASANT**

*Polyplectron schleiermacheri* Brüggemann 1877

Other vernacular names: none in general English use; eperonnier de Borneo (French); Borneo-Spiegelfau (German).

#### *Distribution of species*

Lowland forests of Borneo from Paitan, in the extreme north, to the south-eastern end of the island, and also south-west an unknown distance in the forests between Banjarmasin and Pontianak. See map 19.

#### *Distribution of subspecies*

None recognized here. This form is considered by Delacour (1977) to be a subspecies of *malacense*, but is regarded by Beebe (1918–1922) as a distinct species, and both its plumage and display characteristics would favour the latter position.

### **Measurements**

Delacour (1977) reported that a male had a wing length of 200 mm and a tail of 200 mm, while a female had a wing of 165 mm and a tail of 155 mm. Beebe (1918–1922) reported the male wing length as 200 mm and the tail as 190 mm, and the female wing length and tail length as 180 mm in both cases. No weights or egg measurements are available.

### **Description (modified from Delacour 1977)**

#### *Adult male*

Crest short and barred grey and black, the centre glossed with green; ear-coverts black; a large ruff of disintegrated feathers barred black and pale grey, the tips metallic violet-blue; upperparts as in *malacense* but darker, the ocelli smaller and greener; tail buff, spotted with dark brown and with a subterminal brown band; there is a green ocellus on the outer web of the lateral rectrices and a dull black spot on the inner web; throat and upper breast pure white; sides of breast metallic blue-green; centre of lower breast white, the rest of the underparts black with whitish shafts and tiny vermiculations; under tail-

coverts spotted brown and black with a black patch near the tip. Iris bluish; facial skin red; bill and feet dark grey.

#### *Female*

Similar to *malacense* but more reddish generally; the tail shorter and the upper coverts often without blue ocelli; those of the rectrices smaller and ill-defined; the rectrices irregularly and coarsely barred with black. The ventral plumage is darker throughout. Soft-part colours like the male, except for a brown iris (personal observation).

#### *First-year male*

Not well described, but apparently with buff mottling on the outer webs of the primaries, and the secondaries with seven or eight rufous bands on the outer webs, and with some mottling of the same colour toward the ends of the inner webs. The tail-coverts are mottled with rufous buff and the black feathers are thickly and finely vermiculated, rather than regularly spotted. The forehead is chiefly black and white, with little green iridescence (Beebe 1918–1922).

#### *First-year female*

Similar to the adult, but without the twin ocelli on the long tail-coverts, this area instead occupied by a subterminal black band flanked by one of buff (Beebe 1918–1922).

#### *Juvenile*

Undescribed, but probably female-like.

### **Identification**

#### *In the field* (17–20 in.)

This is the only peacock pheasant present on Borneo, which simplifies identification. It is almost undescribed as to its ecology and behaviour, but males are the only peacock pheasants that have nearly black underparts, iridescent green on the sides of the neck and forebreast, and a nape that is greenish to violet in colour, with recurved feathers. Females are best recognized by their association with males, but very closely resemble females of the Malayan peacock pheasant.

#### *In the hand*

Males are easily recognized, owing to their distinctive nape, which resembles a Victorian ruff of grizzled grey, black and metallic green to violet, and their distinctively blackish underpart colouration. Females have slightly shorter tails than those of the Malayan species (c. 155 mm vs 180–190 mm), a more reddish overall body colouration, and a much

darker underpart colouration of almost solid brownish black. Delacour (1977) states that the upper tail-coverts lack blue ocelli in this species, but Beebe (1918–1922) states that these are often well developed, and that the gloss in the dorsal ocelli is considerably greater than in *malacense*.

### **Ecology**

#### *Habitats and population densities*

This species is limited to the lowland forested areas of Borneo, where it has been only rarely observed by naturalists. Beebe (1918–1922) was able to find three locality records for it, including the type locality of Moera tewah, south-east Kalimantan, Paitan, in Sabah, and central Sarawak, toward the Kalimantan border. Delacour (1977) reported a fourth locality, in the area between Banjarmasin and Pontianak of south-west Kalimantan.

Nothing is known of its population densities, but Beebe (1918–1922) judged that the birds must be extremely uncommon, inasmuch as the natives he queried were so unacquainted with them.

#### *Competitors and predators*

This species occurs in the same area as the great argus and a species of civet cat (Beebe 1918–1922), but the interactions among these are unknown. The wattled pheasant also occurs in the same general area and probably occupies similar habitats, as do crested and crestless fireback pheasants.

### **General biology**

#### *Food and foraging behaviour*

Nothing is known of this in the wild. In captivity the birds are much like the Malayan peacock pheasant and others of the genus, eating a wide variety of foods, but tending toward an insectivorous diet.

#### *Movements or migrations*

There is no information on this subject.

#### *Daily activities and sociality*

Nothing has been reported on this.

### **Social behaviour**

#### *Mating system and territoriality*

Judging from behaviour of captive birds, these are quite asocial, and must be kept in pairs or alone in order to avoid birds killing or otherwise harming one another.

Territorial or other self-advertisement calling by males is as yet unreported.



*Voice and display*

The little that is known of this derives from a few birds that have been kept by Vern Denton, of Livermore, California. He reported (Denton 1978) that the hand-raised male in his possession is highly aggressive, and assumes a ruffled-feather posture whenever he senses an intruder in his domain (Fig. 39). In this posture he stalks silently about, presenting a very different appearance from that normally seen in wild-trapped males. Denton did not mention any calling at this time, or any crowing at other times, and when I observed the bird he remained completely silent although he retained the aggressive pos-

ture constantly, sometimes thrusting the head more forward, but generally resembling a strutting turkey. During intense threat the male would assume a more asymmetric posture, with the spread tail tilted toward me, and the farther wing surface raised slightly. A true frontal display was never seen even immediately before an actual attack, during which the bird would fly into my face and attempt to strike with the feet. The central iridescent green breast feathers were vertically parted to reveal a contrasting white stripe, which at maximum was almost an inch wide. The crest of the head was also raised to form a nearly triangular shape from the front, and



Fig. 39. Postures by male Bornean peacock pheasant, including lateral display with anterior-posterior head-jerking (A and B), frontal view of crest and breast (C), and maximum lateral display (D). After photographs by the author.

the feathers formed a pointed tip toward the end of the bill, as in the Malayan species. According to Mr Denton, male display to the female is also lateral and is not very long maintained nor prolonged. The only time he has observed a frontal display was when the male was offering the female a tidbit, when 'he had real mating in mind'. At that time the head was lowered almost to the ground, and the wings were lowered to the sides, but were not fully extended.

### Reproductive biology

#### *Breeding season and nesting*

Nothing is known of this under natural conditions. However, in captivity Mr Denton has found that the female of one pair laid three eggs, all in one-egg clutches one year (1972), while an F<sub>1</sub> hybrid female produced with the Malayan peacock pheasant laid from one to seven eggs per year over a five-year period.

#### *Incubation and brooding*

The eggs of this species are very similar to those of the Malayan peacock pheasant and as for the Malayan species, the incubation period is 20–22 days, averaging 21 days (Denton 1978).

#### *Growth and development of the young*

Denton (1978) found that the young of this species were fairly easy to raise, but must be kept separate from other species, including other peacock pheasant chicks, because they seemed to be unable to compete with them. The period of sexual maturity and full adult plumage is apparently two years; Beebe (1918–1922) believed that first-year females had less fully developed ocelli on the tail-coverts than do adults, and although males develop enough plumage to be sexed by the first summer after hatching, they do not breed until their second year.

Mr Vernon Denton has raised several hybrids between the Bornean and Malayan peacock pheasant, and found the females to apparently be fully as fertile and as productive as the full-blooded birds.

### Evolutionary history and relationships

This species has generally been considered only as a subspecies of the Malayan peacock pheasant in recent years, and certainly the two forms are very closely related. However, the highly distinctive male plumage, together with some minor differences in posturing, makes me believe that it might be better to consider them as full species, or at least as allospecies. The two are certainly as different morphologically as are, for example, the grey and

Germain's peacock pheasants. It would seem premature to merge the two before more detailed work on them is done, and thus perhaps tend to neglect the interesting differences between them.

#### *Status and conservation outlook*

Almost nothing can be said with certainty about the status of this elusive species, but its future surely depends on the fate of the primary lowland forests of Borneo. Although this form was included in an earlier edition of the *Red Data Book*, it is no longer considered particularly rare or threatened (King 1981).

### PALAWAN PEACOCK PHEASANT<sup>1</sup>

#### *Polyplectron emphanum* Temminck 1831

Other vernacular names: Napoleon's peacock pheasant; eperonnier Napoléon (French); Palawan-Spiegelpfau (German); sulu maläk, dusan bërtik (Palawan).

#### *Distribution of species*

The island of Palawan, in damp primary forests. See map 19.

#### *Distribution of subspecies*

None recognized.

#### *Measurements*

Delacour (1977) reported that males have wing lengths of 190–195 mm, and tail lengths of 240–250 mm, while females have wing lengths of 170–175 mm and tail lengths of 165–170 mm. Two males averaged 436 g, and two females averaged 322 g (various museum and zoo records). The eggs average 45 × 36 mm, and have an estimated fresh weight of 32.2 g.

### Description (after Delacour 1977)

#### *Adult male*

Long, pointed crest and entire crown dark metallic green; ear-coverts white (some individuals also have a broad white line over the eye and down the back of the neck); rest of the head, neck, entire underparts, primaries and secondaries black; feathers of the mantle, wing-coverts and tertiaries black basally, shiny blue and green in the exposed portions, producing an unbroken metallic effect; back and rump freckled chestnut and black; greater tail-coverts long and broad, almost square, blackish brown spotted with pale buff, with a large subterminal blue-green

<sup>1</sup> Vulnerable species (King 1981).



ocellus surrounded by black and pale grey on each web and terminated by a black and white border; tail slightly graduated, of 22–24 rectrices, similar to the long coverts but greyer, with white spots and borders, the central rectrices having two equal ocelli, those on the inner webs becoming gradually smaller and greyer outwardly, disappearing toward the outer pair. Iris brown, facial skin red; bill and feet black.

#### *Female*

A long, dark brown crest curved backwards and usually held flat on the crown, hindneck blackish, eyebrows, face and throat pale greyish brown; upperparts rich brown finely freckled with buff; the feathers of the wings with large black patches and tawny buff bars; tail-coverts similar; rectrices with ill-defined, broad black subterminal patches, those on the other webs glossed with blue; underparts plain dull brown. Iris brown, bill and feet dark grey.

#### *First-year male*

Much like the female, but larger, the crest longer, lores black and with a few black or blue feathers scattered on the throat, mantle and wings; back more heavily freckled; tail as in the adult male, but a little duller and shorter, spurs rudimentary.

#### *Juvenile*

Much like the adult female, but with black spots on the wings.

### Identification

#### *In the field* (16–20 in.)

This species is limited to the islands of Palawan, where it is the only pheasant.

#### *In the hand*

Males are easily identified by virtue of their extensive amounts of green iridescence on the neck, mantle, and inner wing coverts, and their long, erectile crest. The facial skin around the eye of the male is bright red, and the rounded tail has a buffy terminal band. Females have very short crests, and their only iridescence occurs on the ocelli of the outer tail feathers and longer upper tail-coverts. Otherwise the general colouration is dark brown, with a whitish grey throat and with pale grey extending up from the throat to an area above the eyes.

### Ecology

#### *Habitats and population densities*

This species is associated with primary forests of Palawan's coastal plain and, at least in some areas,

with the more arid woodlands and scrub of the foothills. It is possible, but still uncertain, that the species may be adapted to these secondary forest habitats (King 1981). Its total altitudinal range is unreported, but the maximum land elevations on this small island are only about 2000 m.

There are no estimates of population densities.

#### *Competitors and predators*

No other pheasants occur on the island of Palawan. It has been suggested that wild cats may be a major enemy of this species (Beebe 1918–1922).

### General biology

#### *Food and foraging behaviour*

Nothing has been written on this subject in wild birds, but in captivity the birds are typical peacock pheasants, showing a preference for live insects, fruit, seeds, peanuts, and other foods high in proteins or sugars.

#### *Movements or migrations*

Probably there are few if any substantive movements in this species, given its extremely limited altitudinal range and distribution.

#### *Daily activities and sociality*

Little has been noted on this subject, but the birds seem to occur in pairs even outside the breeding period (Beebe 1918–1922).

### Social behaviour

#### *Mating system and territoriality*

Mr. J. Whitehead (cited by Beebe 1918–1922) believed these birds to be monogamous in the wild. Jeggo (1975), referring to captive birds, stated that they are 'strictly monogamous'.

Territoriality is as yet unproven, but J. Whitehead observed that, like the Malayan peacock pheasant and argus pheasant, males have 'showing off' arenas that are 3 or 4 ft in diameter, and often are on a hump of earth in some unfrequented part of the forest. This would certainly suggest a territorial attachment, although the manner of territorial advertisement is as yet unstudied.

#### *Voice and display*

Although male crowing behaviour may well occur in this species, it is as yet undescribed. Postural displays have been described by several persons (Lewis 1939; Roles 1981; Jeggo 1975, and others). Typically display begins with the male strutting briefly around the female while spreading the feathers of the lower

neck and mantle so as to form a small cape, and while holding a food morsel and bobbing the head up and down. The food is then dropped as the female approaches, and the male immediately assumes a full lateral display posture, with the tail fully spread and twisted so as to be presented almost fully laterally to the female. The farther wing is also raised vertically and partially opened, and the nearer wing dropped to the point where the primaries touch the ground (Fig. 40). The crest is erected and pointed diagonally forward. The head is held in a somewhat retracted position, so that the beak is hidden behind the cape, and only the eye and the white area immediately around it are exposed. This emphasizes the eye in much the same way that is achieved by the display of ruffed pheasants and, more inter-

estingly, by that of the great argus. The entire bird becomes remarkably flattened and rounded in outline, resembling 'a circular plate standing edgewise to the ground and lifted by an invisible stand an inch or two in the air' (Lewis 1939). At the peak of the display the male may utter a prolonged cry like a soft groan. I have noticed that the lateral display is often preceded by a quick and nearly silent wing-flapping, and the display may also be followed by a static arched-neck posture that is held for several seconds. Females sometimes also display laterally in a similar manner to males, as an apparent threat. Copulation is apparently performed without any specific preliminary posturing, but instead the male may simply walk up behind the hen and mount her (Roles 1981).



**Fig. 40.** Postures of male Palawan peacock pheasant, including crest-raising and tidbitting (A), tidbitting before female (B), normal head posture (C), and lateral display to female (D). After photographs by the author.



## Reproductive biology

### *Breeding season and nesting*

It is believed that in the wild the nesting season is during December and January, although no nests have apparently ever been described (Beebe 1918–1922). Nesting on the ground as well as in elevated boxes has been observed in captivity. In captivity, the birds begin laying (on Jersey Island) at the end of March, and may continue until late July or even mid-August (Jeggo 1975). In Florida they begin in early March (Flieg 1973). Jeggo (1975) reported that the average production of eggs per female over a two-year period (involving six layings) was 4.7 eggs per season, while Flieg (1973) noted that from three to six eggs per pair could be obtained in a season. The clutch-size in captivity is usually two, but sometimes only a single egg is laid, especially in younger females. There is an average interval of 21 days between successive clutches (Flieg 1973).

### *Incubation and brooding*

The incubation period is only 18 (Jeggo) to 20 (Flieg) days, probably averaging about 19. It is performed by the female alone, but both sexes call to and help feed the chicks (Jeggo 1975).

### *Growth and development of the young*

Like the other peacock pheasants, the chicks must learn to feed from the ground, after having first been fed beak-to-beak by the parent or foster-parent. In the case of a young bird reared by its parents, it was noted that for the first few days the hen and chick both stayed well under cover, with the male often in close attendance. Gradually the chick would come progressively more out into the open when the female called to it to take food, but it would still quickly return back to cover as soon as possible. Until it was first able to fly up to an elevated roost at 13 days, the female brooded it at night on the ground, whilst the male roosted higher up. When 44 days old it was still roosting at night under the female's wing as initially. By that time it was fully feathered, except for a small area of pin feathers on the centre line of its head. By 70 days of age the development of the juvenal plumage had been completed (Jeggo 1973). A sample of eight newly-hatched young at the San Diego Zoo weighed 19.6 g at hatch-

ing, and 63 g at 29–31 days. At 90 days six young averaged 260 g (David Rimlinger, *in litt.*). Males become sexually active at a year (Flieg 1973) but may require up to three years to attain full plumage. All hand-raised females at least two years old were observed to lay (Jeggo 1975).

## Evolutionary history and relationships

This species is geographically the most isolated of the peacock pheasants, being separated by about 150 km from mainland Borneo, but connected by numerous intervening small islands and relatively shallow ocean depths that were exposed as dry lowlands as recently as Pleistocene times. I believe that its nearest relative is the Bornean peacock pheasant which, as mentioned earlier, shares some interesting similarities in male plumage patterns, such as having a somewhat banded tail and blackish underparts. It is interesting that the Palawan peacock pheasant has apparently abandoned the ocelli pattern on its wings and back for a more uniformly iridescent colour, while retaining a spectacular pattern of paired ocelli on the tail and tail-coverts. Simultaneously it has concentrated anterior visual attention on the bird's actual eye, by outlining it in white and using a posture that tends to project it against an iridescent green backdrop. Evidently this species has also lost all tendencies to perform a frontal display, and instead has evolved a highly specialized lateral posture. Interestingly, the ocelli of the tail and tail-coverts have remained distinctly doubled, rather than tending to merge at the central shaft as is the case in the Malayan and Bornean peacock pheasants. This latter trend anticipates the development of a single central ocellus of the type characteristic of the true peafowl.

## Status and conservation outlook

This is currently considered a vulnerable species (King 1981), although its actual population size remains unknown. In 1974–5 it was found present on the south-eastern two-thirds of the island. The entire exploitable forest area of Palawan is restricted to the coastal plain and is under lease, but as of 1975 only a small proportion of it had been timbered. There were no sanctuaries on the island as of the late 1970s (King 1981).

# 14 · Genus *Rheinartia* Maingounat 1882

The crested argus is a large, tropical pheasant in which sexual dimorphism is well developed, and the tail of males is greatly elongated and up to four times the length of the wing. Both sexes have a short occipital crest of stiff, upturned feathers, and most of the body plumage is uniform brown with blackish barring and buffy freckles or vermiculations. The tail is of 12 rectrices, and in males is greatly compressed and strongly graduated, with the central rectrices more than five times the length of the outermost ones. The rectrices and their coverts are marked with spots and streaks of brown, chestnut, white and grey, but lack definite ocelli. The moult pattern is as described for *Polyplectron*. The wing is strongly rounded, with the first primary longer than any of the four outermost feathers, and the fifth and sixth the longest. The tarsus is relatively short and lacks spurs in both sexes. Females differ from males mainly in their shorter and less ornamental tail. A single species is recognized.

## CRESTED ARGUS<sup>1</sup>

*Rheinartia ocellata* (Elliot) 1871

Other vernacular names: Rheinard's ocellated pheasant, ocellated pheasant, Rheinarte ocellé (French); Perlenpau (German); tri (Annam, Vietnam).

### *Distribution of species*

Indochina, from Vietnam to the Malay Peninsula, in damp forests between sea level and 5000 ft. See map 21.

### *Distribution of subspecies*

*Rheinartia ocellata ocellata* (Elliot): Rheinard's crested argus. Central Vietnam from Quinhon in the south (lat. 14° N) to Vihn and the Tranninh (Laos) in the north (lat. 19° N).

*Rheinartia ocellata nigrescens* Rothschild: Malay crested argus. Malay Peninsula, the lower levels of Gunong Benom and Gunong Tahan in Pahan, possible also the mountains of Trengganu and southern Kelantan.

## Measurements

Delacour (1977) reported that adult males of *ocellata* have wing lengths of 350–400 mm and tail lengths of 1500–1730 mm, while first- and second-year males have much shorter tails. Females have wing lengths of 320–350 mm, and tail lengths of 350–430 mm. Males of *nigrescens* have wing lengths of 370–400 mm and tail lengths of 1500–1620 mm, while females have wing lengths of 320–340 mm and tail lengths of 370–400 mm. No weights are available. The eggs average about 64.5 × 46 mm, and have an estimated fresh weight of 75.3 g.

## Description (after Ogilvie-Grant 1893)

### *Adult male (of ocellata)*

General colour of the upperparts dark brown, mixed here and there with red, each feather thickly covered with small white spots and markings; on the outer webs of the secondaries these markings take more the form of irregular oblique white lines; top of the head covered with short, velvety feathers, brownish black in the middle and white on each side; a high occipital crest of erect hairy feathers, white in the middle and reddish brown on the sides; ear-coverts brownish black like the top of the head; chin and throat whitish, gradually shading into rufous around the sides of the neck; underparts similar to the upperparts but more mixed with dark chestnut, and each feather with a more or less marked shaft-stripe of deep chestnut; the upper tail-coverts and enormously elongated pair of centre tail feathers have a grey ground-colour, thickly covered with larger spots and markings of chestnut, the spots on either side of the shaft with black central rings and smaller rounded dots of white; the outer tail feathers have a reddish brown ground-colour, and are thickly covered with round white spots surrounded by rings of black. Iris brown, bill pink, paler at the tip and deeper over the nostril; legs brown, sometimes slightly pinkish (Delacour 1977).

### *Female*

General colour umber brown above, each feather transversely mottled with black and buff; these

<sup>1</sup> Rare species (King 1981).





**Map 21.** Distribution of Rheinard's (R) and Malay (M) races of crested argus. Mountainous areas of the Malayan Peninsula are also indicated, but the known range of the Malayan race is limited to the locations shown by the arrows.

markings stronger on the secondaries and rectrices; underparts brown, finely vermiculated with black; crest much shorter and less full than that of the male, the erect plumes in front being blackish white, and the more recumbent ones on the nape dirty whitish buff. Iris brown, bill brown, the culmen and gape pinkish; legs brown (Delacour 1977).

#### *Immature male*

First- and second-year males are much like the adult, but have shorter tails.

#### *Juvenile*

The sexes can be distinguished as soon as they begin to grow feathers; the female has bars on the wings while the male is spotted (Delacour 1977).

#### **Identification**

##### *In the field* (30–94 in.)

This extremely rare and elusive species of Malaya and adjoining Laos and Vietnam is limited to heavy forests. It is unlikely to be confused with any species except for the great argus, from which males can be distinguished by their short bicoloured crest, their extremely long and broad tail feathers, and their brown rather than reddish legs. Females are also crested, and have pale greyish faces that contrast with their darker brown neck and body colouration, and have somewhat barred patterning on the wings and tail. The male's call is a loud *kuau* or *ho-huiho*, repeated several times, and much like that of the great argus. It is a long, drawn-out call that carries great distances. Soft, sibilant chuckling notes are uttered by both sexes.

*In the hand*

The male's enormously long and broad central tail feathers (130 mm wide and up to 1730 mm long) are unique among birds. Younger males have shorter tails, but these too are relatively broad and are distinctively stippled with tiny buff spots and larger brown spotting. Females have a relatively shorter (350–430 mm) tail that is heavily freckled and barred, and a brownish occipital crest that becomes black anteriorly. The somewhat similar great argus female has no crest, and exhibits rather bluish facial skin.

**Geographic variation**

Geographic variation is rather slight in this species, with males from the Malay Peninsula averaging darker than those of the nominate form. They also are more regularly spotted, have a longer and whiter crest (85 vs 60 mm), underparts that are more spotted with white, and a darker tail. Females are slightly brighter, with lighter underparts, and underparts that are more closely marked with black (Delacour 1977).

**Ecology***Habitats and population densities*

In Indochina, the ecological range of this species is from sea level to as high as 5000 ft, and the birds are associated with hilly lowland and lower montane forests, on very damp slopes of mountains, especially those slopes below about 900 m (300 ft), according to Delacour (1977). On the Malayan Peninsula this species is known only from Gunong Benom, Gunung Tahan and Gunung Rabong, as well as one possible locality between these last two points (Davison 1980b). All its known locations are on isolated mountain blocks over 5000 feet in elevation, lying to the east on the main dividing range in the Peninsula (Davison 1977), and all observations have been between 790 and 1080 m (Davison 1979c). Studies by Davison (1978a; 1979c) on Gunung Rabong suggest that the birds are mainly to be found near the 980 m (3000 ft) contour level, and their dancing grounds were located in a transitional area between lowland dipterocarp forest and lower montane forest.

The population density estimated by Davison (1978a) for all of Gunung Rabong in 1976 was about fifteen calling males, and he said that the best means of expressing population density was his estimated average distance of 1100 m (range 720–1440 m) between dancing grounds. The total population of this area might be under 50 birds (King 1981).

*Competitors and predators*

Davison (1980b) has suggested that competition with the great argus on the Malayan Peninsula has forced the crested argus into its highly restricted altitudinal zonation pattern in that area. In Annam there is no contact with any comparably sized pheasant, and perhaps for these reasons it exhibits a much wider and more altitudinally diverse ecological range. Its predators have not been specifically identified, although in Malaya it reportedly occurs in the same areas as tigers and leopards (Beebe 1918–1922), and doubtlessly also encounters many other smaller predators.

**General biology***Food and foraging behaviour*

Beebe (1918–1922) summarized the little information then available, saying that the birds eat crickets, other insects, and even little frogs, but predominantly insects. However, captive birds would also take grain and other foods of barnyard fowl. Davison (1978a) studied 17 droppings collected on the dancing ground of one male, and found that at least 90 per cent of the material was nearly digested materials that seemed to be of vegetable origin, while fragments of ferns, liverworts, and vegetable fibres were also found. Fruit remains were present in nearly 60 per cent of the droppings, and palm fruit (*Calamus*) remains were found in about 40 per cent. Invertebrate fragments, perhaps from ants, were observed in nearly 60 per cent of the droppings.

*Movements and migrations*

There is no evidence of any significant movements in these birds, although Davison (1979c) stated that the altitudinal range of these birds outside the breeding season (790–1080 m) may be somewhat broader than the range of the dancing grounds (820–1050 m).

*Daily activities and sociality*

During the calling season, males begin about 7.00 a.m., and continuing until about noon, depending upon the individual and the day. Males then leave their dancing grounds, and only occasionally call in late afternoon at about 5.00 p.m. Nocturnal calling occurs from about 7.00 p.m. onwards, and is less frequent than during the day. Some night calling may also be done from roosting sites (Davison 1978a). There is no evidence of sociality in this species, even out of the breeding season, although females probably remain with their chicks (one or two) for a prolonged period. Further, when the young became independent they continue to live together for some time, according to Beebe (1918–1922).



## Social behaviour

### *Mating system and territoriality*

The spacing behaviour of calling males indicates a territorial behaviour; judging from Davison's (1978a) sketch map the birds seemed to be maximally dispersed with a rather consistent distance separating them. The male's calls carry considerable distances, and consist of loud and resonant whistles that may be given in response to calls of others of their species, of great argus, and to a lesser extent to a wide variety of other loud noises (Davison 1978a). The dancing grounds of the males are fairly small, consisting of cleared areas of from less than one to up to four metres in length and width. They are level, or sometimes are situated on slight rises or humps, and seem to be especially associated with mountain ridge saddles or shoulders. Such sites are very limited, and there is probably considerable competition for suitable dancing grounds. Thus, sites may be used for several years, certainly at least for as many as four seasons (Davison 1978a). Beebe (1918–1922) stated that the bird selects a flat and clear area of ground, often at the foot of a great tree, on a branch of which the female might perch and watch while the male displays. That point would seem unlikely, and it seems more probable that the female would approach the male on foot.

### *Voice and display*

Beebe (1918–1922) reported that the major calling season of the Annam race is in March and April, while on the Malayan Peninsula the calls have been heard both in March (Davison 1979c; Medway and Wells 1976) and May (Davison 1978a). Davison reported two types of male calling; short calls and long calls. The onset of short calling marked the start of the breeding season in his view, and he first heard it on 21 March. This call is trisyllabic and was transcribed by him as *oo-kia-wau*, the first syllable slow and humming, and the second and third rapid and high-pitched. Males typically call from one to eight times in rapid succession, then pause for about 15 min before calling again. The corresponding call of the great argus is disyllabic, lacking the introductory note, and is lower pitched. The longer call consists of a series of from 8 to 17 loud disyllabic notes, with only the first introduced by the humming note. It resembles a similar call of the great argus, but seems more melodious at close range (Davison 1978a). Long calls are apparently given mostly in the morning, at various locations away from the display grounds, while short calls may be uttered at the dancing ground, from a few metres away, or from the roost at night. A sibilant, mellow clucking call was also heard by Davison from a male standing on its dancing ground.

Davison (1978a) observed a limited amount of display by a male on its dancing ground, which threw vegetation fragments about with his beak. He then stood motionless on his display site, with his white crest fully exposed. Over the next 45 min the crest was gradually lowered, but the throat and neck feathers remained ruffled. Short calls were uttered at intervals of 7, 11, and 18 min, and an hour after its initial calling the bird fled, having seen Davison. During calling the head is thrown back, and the crest is erect (Huxley 1941).

Seth-Smith (1932) noted that a captive male displayed in April and May, raising its crest feathers in such a way that the white area resembled a large powder-puff. The male then ran around the hen, with his broad tail feathers greatly spread. Huxley (1941) also noted the similarity of the raised crest to a powder-puff, which he said is raised in preparatory phase, with the tail spread only somewhat, and the wings not dropped. The male then runs past the hen, with the tail feathers spread vertically so that they cover something like twice the area of the resting position. The wings are also drooped, and the body is slightly inclined toward the female, and the head is low, with the neck outstretched. There is apparently no tendency toward a frontal display in this species (Fig. 41). Taka-Tsukasa (1929) stated that during the lateral display the bird is shaped like a 'straight-lined broad tape', and during the run it occasionally stops, lowers its neck a little, and opens its wings. Roles (1981) stated that in intense display the males may leap into the air or pick up stones.

## Reproductive biology

### *Breeding season and nesting*

Judging from limited information, the breeding season probably begins in March in both Annam and Malaysia. No nests seem to have been found in the wild by biologists, although Beebe (1918–1922) mentioned that an Annamese native hatched young from two eggs. Although wild birds were brought to France in 1924 by Delacour, it was seven years later that they first began to breed there. They were bred by Taka-Tsukasa (1929) in Japan in 1928, with the male starting to call in February, and the eggs were laid from mid-April to the beginning of July. The female nested on the ground, rather than using elevated nest boxes. In 1929 the female laid four clutches, each of two eggs, and each of the two eggs of the clutch separated by two days. The intervals between the clutches were from about 20 to 27 days. These eggs were all laid on the ground except for a few that were dropped from the perch in 1928, before nesting sites were available.



Fig. 41. Postures of male crested argus, including calling (A), lateral display to female (B), normal head posture (C), crest-raising (D), and maximum wing-dropping and tail-rearing (E). Primarily after photographs in Huxley (1941).

### Incubation and brooding

Incubation has been found to take from 24–25 days, with the birds emerging on the 25th day. Delacour also raised this species in France in 1931, with the female nesting in an elevated basket. In this case three clutches, each of two eggs, were produced at about 18-day intervals, and the chicks hatched on the 25th day.

### Growth and development of the young

The primaries of the chicks are already well developed at hatching, and their tail feathers being to emerge at only three days, according to Taka-Tsukasa (1929). Jabouille (1926, 1930) also raised this spe-

cies at Hue, Annam, in 1925, with a chick being hatched by its mother and surviving for 40 days. As in *Polyplectron* and *Argusianus*, the chick would hide under its mother's tail.

Like the peacock pheasants and the great argus, the young of this species are brooded at night on elevated branches as soon as they are able to fly up to them, with each chick nestling down below its mother's wing, and facing in the same direction. Like peacock pheasants, the mother also feeds them beak-to-beak for the first few days (Delacour 1977). Judging from photographs in Taka-Tsukasa (1929), the birds lose the last of their downy plumage no more than 60 days after hatching, when they are about the size of bantam hens. Apparently at least



three years are required for the male to attain nuptial plumage, but the tail continues to increase in length for a few more years (Delacour 1977).

### **Evolutionary history and relationships**

Davison (1980*b*) has postulated the evolutionary history of the crested argus from a common ancestor with the great argus, and judged that since the separation of these two forms the crested argus has lost its frontal display while the great argus has elaborated its frontal posturing. Davison judged that the two species have probably been in prolonged contact on the Malayan Peninsula, during which time selection for interspecific differences in displays and male plumage pattern has occurred.

### **Status and conservation outlook**

Nothing is known of this species' current status in Vietnam, but it is probably quite precarious because

of all the habitat disturbances of the past few decades. It has not been observed there by ornithologists for over 50 years (King 1981). On the Malayan Peninsula it is known from only a very few localities, and its potential range is not much larger than its known range (Davison 1977). There is no good evidence of its past or present occurrence in Sumatra (Davison 1979*d*). Logging in the species' known range of Malaya has been done up to about 760 m elevation, but was halted in 1975. Fortunately, logging equipment is unable to operate on the steep slopes encountered at the higher mountain levels used by these birds (Davison 1979*c*). This species is considered 'rare' by the ICBP, and a large part of the bird's known range on Gunung Rabong is fortunately in Taman Negara National Park, where the estimated total population may be under 50 birds (King 1981). Given that situation, it would be appropriate to consider the species as 'endangered' rather than simply 'rare', and to institute whatever conservation measures might be possible.

# 15 · Genus *Argusianus* Rafinesque

## 1815

The great argus is a very large, tropical pheasant in which sexual dimorphism is highly developed but iridescence is limited to the ocellus markings on the wings of the male. The central pair of rectrices of males are extremely elongated, up to four times the length of the outermost rectrices, and nearly three times the length of the primaries. The head and neck of both sexes is nearly naked except for the centre of the crown and a short occipital crest, and the body feathers are mostly spotted and finely barred with brown, buff and chestnut. The wings are uniquely shaped, with the secondaries longer than the primaries, and the primaries gradually declining in length from the first outwardly. A series of iridescent ocelli is present on the inner webs of the secondaries of males. The tail is of twelve rectrices, and the moult pattern is as described for *Polyplectron*. The tarsus is relatively long, slender, and lacks spurs in both

sexes. Females resemble males but are duller in plumage, have less highly developed secondaries and rectrices, and a longer occipital crest. A single species is recognized here, but a second extinct species is recognized by some.

### GREAT ARGUS

*Argusianus argus* (Linnaeus) 1766

Other vernacular names: argus pheasant; argus geant (French); Argusfasan, Arguspfau (German); keee (Dutch Borneo); kuang raya (N. Malaya); koew-eau (Sumatra).

### *Distribution of species*

Borneo, Sumatra, and the Malayan and Thailand peninsulas, in mature forests between sea level and 4000 ft. See map 22.



**Map 22.** Distribution of Bornean (B) and Malay (M) races of great argus. See map 12 for current distribution of primary forests in these regions.



*Distribution of subspecies*

*Argusianus argus argus* (Linnaeus): Malay great argus. The Malay Peninsula, Tenasserim north to Tavoy and the Thailand peninsula (lat. 14° N); Sumatra.

*Argusianus argus grayi* (Elliot): Bornean great argus. The island of Borneo.

*Argusianus argus bipunctatus* (Wood): double-banded great argus. Known only from a single feather of unknown origin. Considered by Delacour (1977) and Beebe (1918–1922) to be a distinct species, and by Davison (1983c) to be an extinct form possibly from Tioman Island.

**Measurements**

Delacour (1977) reported that *argus* males that are at least seven years old have primary lengths of 450–500 mm (secondaries 800–1000 mm), and tail lengths of 1160–1430 mm, while younger males have progressively shorter wing and tail lengths. Females have primary lengths of 300–350 mm (secondaries 350–400 mm), and tail lengths of 310–360 mm. The race *grayi* is slightly smaller, with males having primary lengths of 430–470 mm (secondaries 750–850 mm), and tail lengths of 1050–1200 mm, while females have primary lengths of 300–340 mm and tail lengths of 300–340 mm. Riley (1938) reported that four males of *argus* weighed from about 2040 to 2605 g (average 2350 g), and one female weighed about 1700 g. Stephan Wylie (personal communication) reported that two males of *argus* weighed about 2043 and 2725 g, while two females each weighed about 1590 g. The eggs of *argus* average about 68 × 44.5 mm, and have an estimated fresh weight of 74.3 g.

**Description (after Baker 1928)***Male (of argus)*

Centre of crown from forehead to nape black, the latter forming a small crest; feathers of the neck sparse, barred black and white, the latter changing to rufous near the back; sides of head, chin, throat and sides of neck nearly bare with fine shaft-like feathers scattered thinly over the whole surface; upper back, scapulars and wing-coverts blackish brown; barred and edged with buff and dark rufous; lower back, rump and shorter tail-coverts rufous buff very finely edged and boldly spotted with black, the tail-coverts palest and dullest; longest outer tail-coverts white, densely covered with kidney-shaped spots of black centred with buff; primaries purple-grey changing to buff on the innermost, freely spotted with black and buff kidney-shaped markings, most numerous on the outer webs and bases; on the inner webs there is

a broad line of pale rufous or cinnamon densely spotted with small white specks, this line shortest on the first primary, longest on the innermost; fine bars of black connect this band with the blue shafts; outer secondaries like the primaries but with broad white margins to the inner webs and the spots on the outer web developed into black bands; on the outer webs near the shafts there are ocelli of iridescent buff, green-grey and purple surrounded with black and with an outer ring of pale buff; the inner secondaries are without ocelli and are mottled black, rufous, and brown with white spots, over all of which there is a faint purple sheen; on each of the secondaries there is a broad ill-defined band of deep purple with white spots and specks and faint rufous bars; central rectrices black shading to rufous-chestnut on the edge of the outer web and to pale grey on the inner web; both webs spotted with white, the spots smaller and surrounded with black on the outer webs, tips dull white; remaining rectrices blackish speckled with white and indistinctly mottled; breast to vent chestnut-rufous, dotted with black and white on the foreneck, mottled and barred with black elsewhere; centre of vent dull unmarked ashy. Iris brown, hazel or greenish brown; bare skin of head and neck dull pale slate to bluish grey or bluish plumbeous; bill light bluish horny; legs and feet pale dull crimson pink to vivid red or coral-pink.

*Female (of argus)*

Forehead to nape dull rufous buff, the feathers edged black, more pronounced down the centre of the crown; a crest of bristly dark grey feathers; nape bright chestnut rufous, the bases of the feathers vermiculated darker; mantle less bright and more vermiculated, the upper back, scapulars and wing-coverts about equally black and rufous, the latter colour paling posteriorly; lower back, rump and upper tail-coverts with more definite bars of black mottled with buff; primaries chestnut, speckled with black on both webs but brighter on the outer web; secondaries boldly mottled black and buff, tinged with chestnut on those next to the primaries; below chestnut, bright and almost immaculate on the foreneck and dullest and inclined to buff on the flanks and abdomen, very finely stippled with dull rufous. Skin of head and neck dull grey or plumbeous to dark blue; legs and feet pale vermilion; bill horny white or greyish white.

*Juvenile male*

Like the female, but more reddish and boldly marked; the crest short and brown. Males soon develop longer wings than females (Delacour 1977), and begin to exhibit black crest feathers.

### Identification

#### *In the field* (30–80 in.)

Limited to Borneo, Sumatra, and the Malay Peninsula, this species is unlikely to be confused with any other species anywhere except on the Malay Peninsula, where the crested argus also occurs. The male great argus is unmistakable owing to his enormously long and relatively narrow central tail feathers, and his greatly elongated secondary feathers, which are longer than the primaries. Females somewhat resemble males, but have shorter tails and secondaries, and lack the iridescent ocelli typical of that sex. Both sexes have only short crests and have reddish feet, which separates them from the crested argus. The male's long call is a loud, musical *kwow-wow*, or *kweau*, which carries great distances. The other male calls include a short call that is a high-pitched note lasting less than a second, and an alarm call. Females also utter repeated *wow* notes. The birds are associated with heavy tropical forest, and are much more likely to be heard than seen.

#### *In the hand*

The incredibly long central tail feathers (over 1100 mm in adult males) and the inner secondaries that may reach 1000 mm provide positive identification of males. Females have bluish facial skin, short and brown crests, and pale red legs that are relatively long (tarsus 85–95 mm).

### Geographic variation

Known geographic variation in this species is rather slight, with males of the Bornean race slightly smaller and greyer than those of the nominate form. They are also more reddish orange below, the back is pinky buff rather than yellowish, the spotting of the rectrices and tertials is mostly white rather than white and buff, the upper breast is orange-chestnut rather than dark chestnut, and the rest of the underparts are also chestnut rather than brownish, with only fine black and buff vermiculations. Females are lighter brown underneath, and have more reddish orange on the neck and back. The single specimen of *bipunctatus* is known only from a primary feather that has a pattern on both webs resembling the inner web of typical *argus*. Unless this is the result of a genetic aberration, it suggests that a population of this species with additional geographic variation may once have existed. Delacour (1977) suggested that perhaps it occurred in Java, and has now become extinct, but Davison (1983c) believes that it may have occurred on Tioman.

### Ecology

#### *Habitats and population densities*

Davison and Scriven (in press) found the Malaysian race of this species to be associated with lowland and hill dipterocarp forest sites, but lacking in montane forest and also in coastal gelam (*Melaleuca*) forests, peat swamp forests, and heavily disturbed lowland dipterocarp forests that were highly fragmented and hunted. Toward the northern end of its range it becomes more restricted to hills, which are moister and more nearly evergreen, but in areas where the crested argus was present on mid-mountain levels this species is lacking. The birds are less common on level or gently sloping country than in hilly areas (Davison 1984). In Borneo, the birds also occur in lowland forest, exclusive of extensively cleared and populated or flat and swampy jungles, and in low montane forests as high as 3000 ft (Smythies 1981).

Densities in males per km<sup>2</sup> in Malaysia ranged from as low as about 0.3 individuals on low and level sites to as high as 4.5 on steep land with many small hills (Davison and Scriven in press). On such flat sites as Pasoh and Kuala Lompat the average distances between male display sites was about 450 m, and the minimum 260 m, while at a hilly site (Ampang) the average was 375 m and the minimum was 280 m, with fairly uniform spacing. At Kuala Lompat 75 per cent of the males were found to call no more than 200 m from permanent water, and most of their home ranges were on alluvial soils, while at the hilly site no part of their habitat was more than 300 m from permanent water (Davison in press, b).

#### *Competitors and predators*

Davison (1980b) has suggested that this species competes strongly with the crested argus, and that the present range of the latter in Malaysia has been affected by this competition, which seems to result in mutual competitive habitat exclusion, although it is not clear which species excludes the other (Davison and Scriven in press). In Borneo, Beebe (1918–1922) estimated that the great argus comprised 6 per cent of the pheasant population in one rather disturbed area, with the wattled pheasant also 6 per cent and the firebacks making 88 per cent. However, in a less disturbed area the argus comprised an estimated 65 per cent, the wattled pheasant 15 per cent, and firebacks the remaining 20 per cent. It seems unlikely that any of these smaller species pose a competitive threat to the argus, although Beebe believed that the spurless argus would have little chance in a fight with the well-armed fireback.

The major enemy of the argus pheasant is cer-



tainly man, for the birds are easily trapped on their display sites, and their feathers are used as ornaments. Beebe mentioned civet cats and musangs (*Paradoxurus*) as possible predators, but provided no positive evidence. He believed that the loud and prolonged calling of males would tend to place the birds in some jeopardy, and said that it probably relies on its acute hearing for warning of danger. The birds can run extremely fast, but are relatively poor fliers.

## General biology

### *Food and foraging behaviour*

Beebe (1918–1922) could provide little information on the Malayan form of argus, other than that they feed on fallen fruit, ants, other insects, slugs, and various shelled molluscs. He found that the Bornean birds seem to eat primarily ants, but also leaves, nuts, and seeds. Surprisingly, he found no evidence of termites in their diet. Davison (1981*e*) observed that Malaysian birds consumed a wide variety of invertebrate and plant materials, based mainly on the analysis of droppings. Fruits of the plant families Palmae, Annonaceae, and Leguminosae predominated in the diet, including many climbing species, as well as some from various understorey trees, and a few from canopy and emergent species. Termites were found in only one of 138 droppings, and in one of four gizzards. However, ants were found in many droppings and probably comprise a majority of the invertebrate food, which is consistent with their abundance in the litter fauna.

While foraging, the birds are typically solitary except for females leading young. Foraging birds walk slowly, and in a meandering manner, pecking at the leaf litter and sometimes also at the leaves of shrubs. After each peck the bird typically raises its head to look about, presumably for possible danger. Scratching for subsurface materials under the litter was not observed by Davison. Apparently large prey items are favoured over smaller ones.

### *Movements or migrations*

Davison (1981*e*) used radio telemetry to determine home ranges in two males over periods of several months. He found that the home ranges of these birds were surprisingly small, and they had still smaller core areas of intense use. The maximum daily travel noted for a single day was 800 m for one male and 910 m for the other; the core-areas of use (where at least 50 per cent of the observations were made) varied monthly from as little as about a tenth of a hectare to slightly more than half a hectare. Even outside of the breeding season, from November to February, the birds had relatively

small total home ranges that collectively averaged only about 2.5 ha during the months from October to March.

### *Daily activities and sociality*

All the evidence would suggest that these birds are relatively solitary (Beebe 1918–1922; Davison 1981*e*), and rarely if ever are seen in groups larger than a female and her two young. Davison (1981*c*) observed by telemetry that in November two males foraged for short periods in the morning and evening, and otherwise spent their daylight time perched, averaging 81 and 90 per cent of the daylight hours thus occupied. Beebe (1918–1922) observed a night-time tree perch in Borneo, and watched a male 'climbing' up to it one night, but did not describe its characteristics. A good deal of nocturnal calling occurs during some months, especially on moonlit nights, when it might go on all night. The birds also sometimes call throughout the day on cloudy days, but the highest levels are after sunrise and also again between sunset and darkness, according to Beebe (1918–1922). He believed that all adult male calling was done from the dancing ground, implying that the birds perch at or very near their own dancing site. However, Davison (in press, *b*) noted that some males without dancing areas called from the ground as they wandered about, and that some calls are uttered from the roosts.

## Social behaviour

### *Mating system and territoriality*

There can be no doubt that this is a polygynous species (Davison 1981*d*), and probably the only real contacts between adult males and females occur at the dancing site in conjunction with fertilization.

Territory sizes during the breeding season are apparently fairly large, as indicated by the earlier data on dispersion of male dancing sites, with an average of about 400 m separating them. However, it is not known to what extent all of this area may be defended. Davison (in press, *b*) found that in one area (Ampang) the display site of males that died were used in following years by other males, suggesting that the density of calling males might be affected by the availability of suitable hilltop sites. In another area, striking topographic features were lacking, and the number of calling males varied with the relative food abundance in the form of fruiting plants.

### *Voice and display*

The advertisement of male display sites is done by daily calling. Davison (1984) noted that calling might begin at any time between 6.30 and 10.15 a.m.

at two flatland sites, while at a favoured hilly site it always began before 7.00 a.m. and usually continued until after 11.00 a.m. Males at the latter site called nearly every day. Males in this general region typically call over a long seasonal period, from January or February until sometime between early June and late September, with mating and nesting apparently occurring in June (Davison 1981e).

The male's calls consist of three types of hooting, which are audible for up to about a kilometre, a yelp-like alarm call audible for several hundred metres, and various gentle clucking calls, according to Davison (1981d). The 'long call' is a series of 15–72 hoots, starting as monosyllables but becoming higher in pitch and disyllabic toward the end. These calls are uttered by adult males throughout the year, but especially at the start and end of the breeding season, around February and August. They seem to in part serve as vocal contests between males for dancing ground sites. Long calls also have occasionally been heard from females. The 'short call' is a high-pitched disyllabic note, usually lasting just under a second, and uttered every few minutes in bursts of up to 12 calls by males on their dancing grounds. They are also uttered from the roost at night. The number of notes per burst and the number of bursts per hour were found by Davison to vary but overlap among six different males, and these differences were insufficient to distinguish individuals, although other auditory cues might allow for such separation. Areas over which a single male could be heard were found to vary from about 38 to 145 ha, with the smaller ranges in dense vegetation and level sites, and the larger areas from hilltop sites. Males apparently begin to call at about 12 months of age, and perfect their calls by about 20 months. Young males may call occasionally and try to make dancing grounds, but these efforts never result in a large cleaned space as typical of adults.

The size of the display site, or dancing ground, is variable, but it is typically larger than 12 m<sup>2</sup> by the end of the display season, and rarely may be as large as 72 m<sup>2</sup>. Each site has one or two regular entrance and exit routes that are used by the male. Davison (1981d) doubted that the clearing of the sites of debris was related to ground predator detection, but may serve to amplify the sound of foot-stamping in males, and may also be visually significant to females. Davison noted that actual cleaning behaviour comprised a very small percentage of the time spent by the male on the site, with inactive periods comprising over 80 per cent of the time, calling about 13 per cent, preening about 2 per cent, and actual postural display a small fraction of 1 per cent of the total time.

The postural displays of this species have been

described by many authors (Beebe 1918–1922; Seth-Smith 1925a, b; Bierens deHann 1926; Davison 1982). The most complete of these is that of Davison, which is the primary basis for the names and descriptions of the displays here mentioned, all of which are associated with male display sites or 'dancing grounds'.

Cleaning of the display site occurs throughout the breeding season, and may be performed as leaf-throwing with the beak, pecking of overhanging vegetation, bill-scraping around the bases of saplings, and wing-beating with forceful movements that fan away light debris. Of these, leaf-throwing is the most commonly used method. Actual posturings (Figs. 42 and 43) may occur in the absence of any female, but when females are present they are more prolonged, foot-stamping is more vigorous, and there are more variations in individual display movements.

Head-feather ruffling consists of the erection of head, neck and upper breast feathers, producing a very bushy appearance. This posture seems to represent a state of display readiness, and typically precedes foot-stamping (David Rimlinger, personal communication). Likewise, general body-shaking typically precedes each renewal of display activity. The first conspicuous posturing during a display sequence is foot-stamping, in which the male walks around the dancing ground, with his head held low and the neck arched, making stamping movements of the feet sometimes audible for up to 25 m. These stamping movements are made methodically, at the average rate of nearly three per second (personal observation). Stamping continues for a variable period, but if the female is present the male may shift to a 'tail-high walk', in which he is oriented laterally to the female, with the tail held nearly vertically. The head feathers are still ruffled, and the posture is frequently interspersed with tidbitting movements. These consist of ritualized ground-pecking movements in which the beak sometimes does not actually touch the ground, or may involve pecking and flicking of leaf litter in the direction of the female, which often attracts the female toward him. No calling is associated with this tidbitting behaviour. Tidbitting may also occur during a 'cringing run', in which the male trots in arcs around the female in short and rapid steps. However, on attracting the female, the male is more likely to perform a lateral display, running past her with the nearer wing lowered and the farther one raised, then turning and repeating the movement in the opposite direction. In this posture the ocelli of the wing feathers are variably visible. Frequently the male hisses as he performs this display. David Rimlinger (*in litt.*) has observed a 'rush' display not described





**Fig. 42.** Postures of male great argus, including foot-stamping (A), tidbitting (B), crest-raising (C), normal head posture (D), and lateral display to female (E). After photographs by the author and David Rimlinger.

by other observers, which has been observed as the female enters the arena opposite from where the male is standing. He then rushes straight towards her, making a hissing sound. This display was observed only occasionally, and seemed to be performed instead of or immediately prior to the lateral display. After either a lateral display or intense tidbitting behaviour, the male may quickly swerve to face the female, spreading both wings fully vertically, forming an oval radiating fan of feathers with the two longest tail feathers visible behind the wings. The head, placed behind one wing, is held in such a way that one eye is visible at the carpal joint.

The double wing-fan is essentially funnel-shaped, and the ocelli form a radiating series of artificial 'eyes' extending out from the position of the actual eye. In this extreme posture both legs are synchronously raised and lowered, altering the pressure of the primaries on one another and the ground, producing a rustling sound, while the tail is simultaneously raised and lowered in a hypnotic rhythm. This rocking and tail-pumping activity occurs at a fixed rate of about three pumps per five seconds, and is characterized by a slow downward movement of the tail, followed by a very fast return to the vertical (personal observation). In ten filmed sequences that I



**Fig. 43.** Postures of male great argus, including rushing (A) and full frontal display (B), showing the tail in fully raised position as well as in lowered position (dotted line.) After photographs by the author David Rimlinger.

examined, the number of such pumps in a single sequence varied from three to nine, and Davison observed up to 11 such movements. This phase is clearly the climax, and is held by the male for as long as the female remains close to and in front of him. However, it is apparently not normally followed by attempted copulations (personal observations and David Rimlinger, personal communication).

Copulation has not been described in the literature, but I observed one instance on 28 February 1983, and David Rimlinger has observed it on three other occasions. In the case I observed, the female,

who had been 20–30 ft from the foot-stamping male and not paying obvious attention to him, suddenly moved to the rear part of the pair's pen and squatted. The male rushed over to her and mounted immediately. Copulation lasted only for a few seconds, with the male opening his wings and grasping the nape while mounted. There were no special displays on the part of either bird afterward. In two earlier observations by David Rimlinger it also did not occur during intense male display. Instead, the female walked to the male's arena and squatted down; the male immediately came over and mounted.

Davison (1981*d*) believed that female fertilization



choice among competing males, with or without display areas, based on gross (age-associated) plumage differences or individual display differences, provides a better explanation for the evolution of male plumage and behaviour patterns than that of female comparisons of subtle male plumage variations or minor vocal differences among males.

## Reproductive biology

### *Breeding season and nesting*

Very few nests of this species have been found in the wild. Beebe (1918–1922) observed a recently hatched nest of the Malayan form at an elevation of 2000 ft on a mountain slope covered by palms and bamboos. He did not provide the exact date of its discovery, which was probably in October or even later. He mentioned that chicks have been found in February and August. Davison (1981c) found one nest of this same race in June. Medway and Wells (1976) mention clutches obtained on 20 May and 2 July, and an egg laid by a recently caught female on 27 March. Less is known of the breeding season of the Bornean form, but one captive female at the National Zoological Park in Washington laid a total of 30 eggs in 15 clutches over a 12-month period, with eggs being laid every month of the year, and continuing from March 1973 to March 1974, when the male began to moult (Gilbert and Greenwell 1976). A female of the Malayan race at the San Diego Zoo laid from as early as February to as late as 27 August over a two-year period, producing seven eggs in four clutches in 1982, and seventeen eggs in nine clutches in 1983. The average interval between eggs was two days, and the average between clutches was 25 days (David Rimlinger, *in litt.*). Gilbert and Greenwell (1976) noted the usual interval between eggs to be 48 h, with a maximum of five days, while the minimum interval between clutches was two weeks, and the maximum was a month. In 15 clutches, all were of two eggs except for one clutch of one and one of three eggs.

### *Incubation and brooding*

The incubation period of this species is 24 to 25 days. One nest that was incubated by a female had an incubation period of 24 days and 18 hr, while artificially incubated eggs required from 24 to 26 days to hatch (David Rimlinger, *in litt.*). There is no indication of any male involvement in nest defence or even of the male maintaining any close proximity to the female's nesting site. At the San Diego Zoo, a female laid her eggs in a platform nest 5 ft off the ground in preference to ground sites (David Rimlinger, *in litt.*).

### *Growth and development of the young*

On hatching, the chicks of this species are fed beak-to-beak by the adult bird. One female at the San Diego Zoo left her nest with both chicks the day after hatching. She continued to feed her young in this way for more than 40 days, when the young were removed from the pen. They were brooded with the female on the ground during their first week, and then were brooded about 2 ft off the ground on a dead branch under the female's wing. During their second week after hatching the chicks were observed to half-climb, half-fly up to this branch, suggesting that true fledging may not occur until sometime later. Eight chicks weighed an average of 55.4 g at hatching, and 133 g at one month, while two weighed an average of 446 g at two months (David Rimlinger, *in litt.*). Gilbert and Greenwell (1976) commented on the slow growth rates of the young of this species as compared with more typical pheasants, and plotted weight changes during the first 33 days after hatching for young of the Bornean subspecies. They noted that males may begin to display at less than a month of age, and will begin to call at about 12 months. The number of ocelli and the length of the wing and tail feathers continue to increase with each moult for several years after sexual maturity (Davison 1981d).

## Evolutionary history and relationships

The close relationships of the crested argus and great argus have already been mentioned in the species account of the former, and both are certainly derived from ancestral stock in common with the typical peacock pheasant. Brun (1971) has discussed the theoretical problems associated with the evolution and ontogeny of the complex male ocellated feather pattern of this species, and Davison (1981d) has dealt with the problems of sexual selection in so far as they relate to the evolution of male plumage and behaviour. Davison (1983c) has also discussed the problematic taxonomic disposition of the unique specimen (a single feather) of *bipunctatus*, which he suggested may have been a flightless form that perhaps occurred on the island of Tioman, which has been isolated from the mainland of the Malayan Peninsula for about 15 000–20 000 years. However, I have tentatively relegated this form to the subspecific level.

## Status and conservation outlook

The Malayasian range of this magnificent species is currently being restricted by forest destruction; low-land forests now cover only about 15 per cent of the

peninsula, and total forest cover had declined from 70 per cent to only 42 per cent of the land area by 1978 (Davison 1981c). In Borneo (Sarawak, Sabah, and Kalimantan) the lowland forests may still cover at least 40 per cent of the land area, and thus the species is probably in less immediate danger there. There are as yet only a very few sanctuaries in the probable Bornean range of this species (Sumardja

1981), but it does occur in small numbers in Taman Negara National Park of Malaysia. Both races are now well established in captivity, and under proper avicultural management their numbers are slowly increasing. As perhaps the most remarkable of all the pheasant species in its behaviour and plumage, it is especially important that the conservation of the great argus be carefully monitored.



# 16 · Genus *Pavo* Linné 1758

The peafowl are very large, tropical pheasants in which sexual dimorphism is highly developed, but both sexes exhibit iridescent plumage. A large area of bright orbital skin is present on the sides of the face of males. In males, the tail is hidden by extremely elongated and ornamental tail-coverts, which are iridescent and tipped with complex ocelli, while the tail itself is flat, graduated and composed of 18 (females) or 20 (males) rectrices. Moulting begins with the second pair from the outermost, and proceeds inwardly, with the outer pair being moulted just before the innermost ones. The wing is rounded, with the tenth primary shorter than the first, and the secondaries shorter than the primaries. The tarsus is relatively long, and is spurred in males and often also in females. In females the upper tail-coverts are less elongated and the plumage is generally less brilliant. Two species are recognized.

## KEY TO SPECIES (AND SUBSPECIES OF MALES) OF *PAVO* (in part after Delacour 1977)

- A. Crest fan-shaped, the shafts mostly bare, facial skin white: Indian peafowl.
- AA. Crest straight, with barbs from base to tip, facial skin blue and yellow: green peafowl.
  - B. Wing-coverts black, with a narrow blue border: Burmese green peafowl (*spicifer*).
  - BB. Wing-coverts mostly bright iridescent bluish or greenish.
    - C. Generally brighter, the upper back more 'scaly' with golden green and the mantle more coppery, the lower breast and flanks lighter and brighter: Javanese green peafowl (*muticus*).
    - CC. Generally duller, the upper breast more coppery, and lower breast and flanks duller and darker, and the mantle more bluish: Indo-Chinese green peafowl (*imperator*).

## INDIAN PEA FOWL

*Pavo cristatus* Linnaeus 1758

Other vernacular names: common peafowl, blue peafowl; paon bleu (French); blauer Pfau (German); mohr (India); monara (Ceylon).

### *Distribution of species*

Sri Lanka (Ceylon) and India north to Pakistan (Indus River), the Himalayas and the Brahmaputra

Valley, east to approximately long. 95° E. In semi-open country from sea level to about 5000 ft. Introduced and semi-feral in many other areas. See map 23.

### *Distribution of subspecies*

None recognized.

## Measurements

Delacour (1977) reported that adult (third-year or older) males have wing lengths of 440–500 mm and tail-covert lengths of 1400–1600 mm (rectrices of 400–450 mm), while females have wing lengths of 400–420 mm and tail lengths of 325–375 mm. Males range in weight from c. 4000–6000 g, and females from c. 2750–4000 g (Ali and Ripley, 1978). The eggs average  $69.7 \times 52.1$  mm and have an estimated fresh weight of 103.5 g.

## Description (after Delacour 1977)

### *Adult male*

Fan-shaped crest and head metallic blue; a band from nostril to eye and a large patch under the eyes naked and white; neck and upper breast silky blue with green and purplish shades varying with the light, black metallic light green, each feather bordered with black and having a blue central streak and a V-shaped brown patch; those of the rump with a subterminal border of golden green; rectrices blackish brown with pale mottlings on the outer border; the upper tail-coverts 100–150 in number, forming a train, with long disintegrated barbs metallic green with bronzy lilac or purple reflections and a large subterminal ocellus formed by a deep blue patch surrounded by two broad rings of brilliant blue and bronzy brown, and two narrow ones of golden green and bronzy-lilac; the outer and the longest central feathers have no ocelli; the first has a thick velvety blue-green border on the outer web, the second terminates in a broad black half-moon; scapulars, lesser wing-coverts, and the tertiaries coarsely and irregularly barred pale buff and brownish black; secondaries and their coverts black with a blue tinge on the outer web; primary coverts metallic blue; primaries fulvous; lower breast, flanks and abdomen black and dark green; thighs pale buff with small black bars on the upper half; under tail-coverts



**Map 23.** Probable original distributions of Indian (I) and green (G) peafowl; known distribution of the latter species is indicated by arrows.

soft and fluffy; pale grey with black tips to the long barbs. Iris brown, facial skin white; bill horny grey, legs pale brownish grey.

#### *Female*

Crest, crown, lores, and upper neck chestnut-brown, the feathers bordered with bronzy green; eyebrows, sides of head, and throat white; lower neck, upper back and upper breast metallic green; rest of upperparts earthy brown, vermiculated with pale brown, the primaries and rectrices blackish brown with whitish spots on the outer border or at the tip, the rump and tail-coverts with more whitish vermiculations; lower breast dark brown with broad buff borders to the feathers; abdomen pale buff; thighs, vent and under tail-coverts earthy brown freckled with whitish. Iris brown, bill and legs horny brown.

#### *Second-year male*

Lacking the ocellated train, and instead having a short train of feathers lacking ocelli. Additionally the underparts are green, purple, and black, the throat, crown and nape mostly purple. Both the entire back and the short upper tail-coverts are

barred with green and brown; the crest plumes are glossed with purple; the secondary coverts are dark purple.

#### *First-year male*

With a light buffy brown abdomen sparsely barred with dark brown, the barring becoming heavier on the lower breast; the upper breast, nape, neck and crown green, with an admixture of purple and brown; the tertials, scapulars, and back are buffy brown, with dark brown barring, the upper back also with some green bars passing into the green of the nape; the throat is white, but has a few scattered green feathers; the expanded tips of the crest quills are green; the primaries are chestnut, the rectrices are dark greyish brown. A complete moult apparently precedes this first-year plumage (Marien 1951).

#### *Immature female*

Closely resembles the adult female; probably best distinguished by a somewhat smaller size (Marien 1951).



*Juvenile*

Mantle and rump clouded with dusky; back buffy; scapulars and lesser coverts buffy whiter, more or less clouded with darker; flight feathers creamy white at tip, becoming dusky toward the base, with a narrow dark shaft-stripe and mottling on the inner web. Tail feathers similar (Beebe 1918–1922).

**Identification***In the field* (36–90 in.)

Peafowl are unmistakable in the field, and any wild peafowl occurring west of Bangladesh will be of this species. Both sexes possess whitish cheeks and a tufted and fan-like crest. Females lack the long and iridescent train of males, but their neck and head patterning is very similar. The male's call is a loud, trumpeting *he-on* or *kee-ow*, which carries great distances. Guttural clucking notes are also uttered.

*In the hand*

The fan-like crest of both sexes is unique to this species, and occurs in both adult and immature birds, although it is smaller in the latter. The bare facial skin in males, and the corresponding area in females is also white.

**Ecology***Habitats and population densities*

In its wild state in northern India, the favoured habitats of this species consist of forests growing along hillside streams, in which the undergrowth consists of ber bushes (*Zizyphus*) and thorny creepers, the bushes growing some 10 or 12 ft apart, and spreading out to form table-shaped tops that meet one another to form a continuous mass, allowing the birds to move about easily underneath. Higher up in the hill country they are found in open oak forests, where tiny streams run between the hills and each stream-bank is well covered by bushes, brambles, and reeds. Over much of southern India where the birds are protected they are likely to occur in any patch of jungle, groveland, or bushes near villages and in cultivated areas, and especially in thick and high crops such as sugar-cane (Baker 1930). In general, wild birds seem to prefer moist and dry-deciduous forests in the neighbourhood of streams (Ali and Ripley 1978). Generally the birds are associated with low plains, usually under 2000 ft, but near the northern edges of the range they have been locally recorded to 4000 ft in the Sikkim Hills, as high as 5000 ft in the Nilghiris area of southern India, and to about 6000 ft in Simla (Baker 1930).

There do not seem to be any good estimates of population densities. In their study area around the hamlet of Injar, in Tamil Nadu of southern India, having a total associated cultivated land of about 100 ha (and an unstated area of fallow land and acacia plantings) Johnsingh and Murali (1980) found a population of about 100 adult birds to be present, suggesting a density of something less than one bird per hectare. This group included an estimated 42 breeding females.

*Competitors and predators*

Johnsingh and Murali (1980) listed a variety of potential competitors and predators of this species in this study area; of these the common mongoose (*Herpestes edwardsi*) and jungle cat (*Felis chaus*) were the only mammals listed. Baker (1930) said that the larger cats (leopard and tiger) are generally believed to be serious predators, and that he had often found peafowl remains in association with the tracks of one or the other of these species. Stray dogs cause serious losses of chicks in populated areas.

**General biology***Food and foraging behaviour*

Peafowl are generally believed to be virtually omnivorous (Baker 1930; Ali and Ripley 1978), eating everything from grain and green crops to insects, small reptiles, mammals, and even small snakes. Berries, drupes (such as *Carissa*, *Lantana*, *Zizyphus*) and wild figs (*Ficus*) are apparently favoured foods where they are available. Johnsingh and Murali (1980) found the birds feeding in cultivated fields and on an adjoining acacia plantation as well as in fallow lands, and noted that three birds that were examined had primarily eaten plant materials such as leaves, grass seeds, and flower parts. Some *Croton* fruit, *Acacia* seeds, *Cyperus* rhizomes, and rice were also noted, as were various insects such as termites, grasshoppers, ants, and beetles. Foraging is usually done in small groups, which are primarily harem groups during the breeding season and are segregated parties of adult males and females with young outside the breeding season.

*Movements or migrations*

There is little information on this subject, but apparently the birds use certain traditional roosting trees, at least where they are protected, and return every night to these. Thus, home ranges are likely to be fairly small, and limited to foraging areas radiating out from roosts and within easy walking distances from them.

*Daily activities and sociality*

These birds roost in high, fairly open trees, from which they can see in all directions. When roosting in forests, they select one of the highest trees, well out in the open (Baker 1930). The birds generally roost in rather large numbers in such trees (five banyan trees served as roosting site for about 100 birds in the area studied by Johnsingh and Murali), but during the day they break up into small groups that for much of the year consist of a male and his harem of three to five females. After leaving the roosting areas the birds move into forest clearings, cultivated fields, or other areas to forage during the early morning hours. The middle of the day is spent in shady sites, often very close to water, where the birds drink and preen at length. Late in the afternoon they forage a second time, and return for another drink at dusk before going to roost in the evening.

**Social behaviour***Mating system and territoriality*

All authorities are agreed that this species is polygynous, and that a harem mating system prevails. Obviously not all adult males are able to gather harems; Sharma (1972) observed a sex ratio of 1.7–2.1 males per female in his study area. On the other hand, Johnsingh and Murali (1980) noted a sex ratio favouring apparent females, but admitted that immature female-like males probably affected their estimates. Perhaps only half of the females in a given population are actually breeding birds, as some are too young and others are too old or otherwise unable to breed (Sharma 1972).

Territoriality is as yet unstudied in this species, but the male's loud calling during the breeding season is almost certainly associated with dispersal and spacing.

*Voice and display*

The calls of this species are numerous, and are still only rather poorly described. Johnsingh and Murali (1980) listed 11 possibly distinct calls, of which three or four are associated with various enemies, one with parent–young relationships, and one with sexual behaviour and related aggressive behaviour. The last-named category represents the male's *Kayong-kayong-kayong* call, during which the head and neck are jerked violently, and is perhaps associated with dominance display over females. Males also utter a repeated *may-awe* call, especially during the breeding season, and particularly in early mornings and evenings. This call is uttered both before and after roosting, so it is probably not a territorial dispersion call.

The displays of this species, which can be observed so easily in zoo birds, are almost too familiar to describe. Heinroth (1940) has described copulatory behaviour in the species, and the strutting has been described by various observers (Ali and Ripley 1978; Beebe 1918–1922). The erection of the male's train is brought about by the cocking of the rather long but non-decorative rectrices, and the lateral tail-coverts extend out horizontally and even downward, so that they hide the wings, which partially droop, with the secondaries folded but the primaries extended loosely downward. The whole body is inclined forward somewhat, and the head and neck are erect, in the middle of the radiation pattern of ocelli formed by the tail-coverts. When thus facing a female the male suddenly performs a quivering shake, causing the iridescent train to shimmer, and the feathers of the wings to rustle audibly. Schenkel (1956–1958) considered this display to be a highly ritualized form of tidbitting behaviour, although no food is offered nor is the bill even lowered toward the ground as in the great argus. Heinroth (1940) simply considered the display as a kind of general sexual advertisement, visible at great distances, that would attract any females that might be ready to mate. As a female approaches the male may actually turn away from her, causing the hen to move around and face him. This may be repeated several times before the female crouches and copulation follows. During mating the train is lowered and mounting occurs in the usual galliform manner.

**Reproductive biology***Breeding season and nesting*

Throughout India the nesting season is quite varied, but is apparently always related to the timing of the wet season. In southern India and Sri Lanka it reportedly occurs from January to April. Along the foothills of the Himalayas it also may occur as early as March or April, but usually begins with the start of the summer monsoon, or about the middle of June. In areas where the food is plentiful and there are showers early in the year the birds typically breed from January to April, whereas in other areas where there is a long dry season the birds do not begin to breed until the start of the wet season (Baker 1930). Sharma (1972) confirmed the start of breeding as coinciding with the onset of rain; in his study area the birds bred from June to August. Johnsingh and Murali (1980) noted that at Injar (Tamil Nadu) the birds bred from October to December, which was also related to local precipitation patterns.

Nests are typically well concealed, and often are located under thorny shrubbery such as *Lantana* or *Zizyphus*. In some low areas, where flooding often





Fig. 44. Postures of male Indian peafowl, including frontal display as seen from the front (A), from behind (B), and from the side (C), and wing-lowering during frontal display, with the near-side tail-coverts not indicated (D). In part after Schenkel (1956–58).

occurs, the birds may nest in elevated sites such as in the crotch of a banyan (*Ficus*) tree (Baker 1930). Generally the clutch size has been reported to range from three to six eggs, only rarely larger and with a maximum of eight (Baker 1930). However, Sharma (1972) reported a range of from three to nine eggs in 57 nests, and a modal clutch size of six (27 nests). He confirmed the female's tendency to nest under thorny cover.

#### *Incubation and brooding*

Incubation is by the female alone, and lasts for 28–30 days. Sharma (1972) reported a hatching success of 64 per cent (206 young from 321 eggs). He said that the female incubates for almost 24 hours a day, and that hatching usually occurs on the 29th day, with some also on the 30th day.

#### *Growth and development of the young*

Growth in young peafowl is rather slow, although when the chicks are only two weeks old they are able to jump or flutter up to elevated perches for roosting, where they sit on either side of the female and are covered by her wings (Rutgers and Norris 1970). By 20 days they are able to fly (Sharma 1972). In the wild, there is a rather high post-hatching mortality, with two being the modal number of chicks per brood observed by Johnsingh and Murali (1980). Sharma (1972) also observed a high level of chick mortality, and believed that females are incapable of looking after more than five young. The young are brought to the roosting areas used by adult birds only when they are nearly two months old, and fully capable of flight (Johnsingh and Murali 1980). At four weeks of age the birds begin to develop crests, and when they are two months old the chicks exactly resemble adult females, although they are only half their size (Rutgers and Norris 1970). The plumage of first-year males is quite variable. By their second year, males resemble adult males, but lack ocelli on their train. By their third year males are in full plumage and sexually active, although the length of their train may continue to increase until about the fifth or sixth year (Delacour 1977).

#### **Evolutionary history and relationships**

The relative relationships of *Pavo* to the peacock pheasant, argus pheasants, and African peafowl are still somewhat unclear, but it seems likely that *Afropavo* is the nearest living relative of *Pavo*. de Boer and van Bockstaele (1981) confirmed this relationship on the basis of karyotype similarities, but also observed a rather surprising similarity of both to the chromosomes of guineafowl.

#### **Status and conservation outlook**

This species is the national bird of India, and is under national protection. In some areas it is extremely common and tame, such as wherever it is locally protected for religious or sentimental reasons, and it is generally very common in Gujarat and Rajasthan (Ali and Ripley 1978). There is no reason to consider it in any danger, which is a totally different situation than is true of its close relative the green peafowl.

#### **GREEN PEA FOWL<sup>1</sup>**

*Pavo muticus* Linné 1766

Other vernacular names: green-necked peafowl, paon spicifère (French); Ährenträger-Pfau (German); burong merak (Malaya); oodoung (Burma).

#### *Distribution of species*

Bangladesh to Indochina, and the Island of Java, in lowland and moderate altitude forests, and in open park-like areas from the plains to about 3000 ft. See map 23.

*Distribution of subspecies* (after Wayre 1969, and Delacour 1977)

*Pavo muticus muticus* Linné: Javanese green peafowl. Java and the Malay Peninsula, north to the Isthmus of Kra.

*Pavo muticus imperator* Delacour: Indo-Chinese green peafowl. The whole of Indochina, the extreme south of Yunnan, and Thailand south to Kra and eastern Burma, west to the Salween-Irrawaddy divide.

*Pavo muticus spifcer* Shaw and Nodder: Burmese green peafowl. South-eastern border of Assam in the Chittagong and Lushal Hills, western Burma, probably east to the Irrawaddy River.

#### **Measurements**

Delacour (1977) reported that adult males of *muticus* have wing lengths of 460–500 mm, and tail-covert lengths of 1400–1600 mm (rectrices 400–475 mm), while first- and second-year males have shorter trains. Females have wing lengths of 420–450 mm, and tail lengths of 400–450 mm. Males range in weight from about 3850 to 5000 g (Ali and Ripley 1978). Cheng *et al.* (1978) reported that three females weighed from 1060 to 1160 g. The eggs average 72.7 × 53.7 mm, and have an estimated fresh weight of 114.9 g.

<sup>1</sup> Vulnerable species (King 1981).



**Description (after Ogilvie-Grant 1893)***Adult male*

Differs chiefly from *P. cristatus* in having the feathers of the crest more elongate, normally developed, and equally webbed on each side of the shaft; the whole of the feathers of the neck, upper mantle, and chest dull gold, margined narrowly with black and with a large central patch of deep blue shading into golden green on the sides; the wing-coverts and scapulars black, glossed with purplish blue and margined with green; the feathers of the lower back, rump, and shorter upper tail-coverts more glossed with purple, the longer upper tail-coverts with brilliant green and gold; the thighs glossed with green. Iris brown, naked skin around the eye bluish green, on the cheek orange; bill horn grey; legs and feet dark brownish grey.

*Female*

Differs from the male in having the lower mantle, back, rump, scapulars, and outer secondaries mostly blackish brown, barred and indistinctly mottled with buff and only very slightly glossed with green; the upper tail-coverts extending nearly to the end of the tail and of a golden-green hue irregularly barred with buff. Soft parts as in the male, but the bare facial skin less bright.

*Immature male*

Resembling the adult female, but the lower back mostly bronze-green, shading into bronze on the rump, the upper tail-coverts golden green, with buffy bars, and not reaching the end of the tail. Second-year males are like adults, but have eyeless trains.

*Juvenile*

Like the adult female but duller, with the throat white and the sides of the head partly covered with short white feathers, the male with purer fulvous primaries and a black loreal patch (Delacour 1977). Females have a brown loreal patch and speckled primaries.

**Identification***In the field (40–96 in.)*

Any wild peafowl occurring from Assam eastward is probably of this species, although feral individuals of the Indian peafowl might also occur. The presence of a long, narrow and columnar crest is unique to the green peafowl, as is the bluish to yellowish facial skin, in contrast to the fan-like crest and white facial skin of the Indian peafowl. Otherwise, the two

species are rather similar, and their vocalizations are also similar. The male's crowing is not so harsh nor so penetrating as that of the Indian species, and sounds like *aow-awo*. Likewise, the female's calls are not so loud, but both sexes have loud alarm *kwok* notes and guttural clucking sounds.

*In the hand*

Any peafowl with blue and yellow facial skin and a long, rather tapering crest is of this species. Otherwise, females of the two *Pavo* species are similar, but the green peafowl averages slightly larger, and its flanks and underparts tend toward blackish, while in the Indian peafowl the lower flanks and sides are mostly white or buffy.

**Geographic variation**

Geographic variation in this species is limited to plumage colouration and is apparently clinal. The brightest and greenest of the three subspecies is the most south-easterly (Javan) race, while the most north-westerly (Burmese) form is distinctly duller and bluer, especially in males. The wing-coverts of the Javanese races are brightly iridescent blue and green, but in the Burmese races the coverts are black, with only a narrow bluish border. The secondaries of the Burmese races are also darker, as are the abdomen and flanks, and the facial skin is less bright in males. Females are also generally duller, and have more extensive brownish black in the plumage (Delacour 1977).

**Ecology***Habitats and population densities*

Baker (1930) described the habitats of this species as locally quite variable, including in various areas such diverse habitats as elephant grass, open dry forests, and the densest thorn and bush undergrowth of evergreen forests. In all cases a nearby supply of good and plentiful water seems to be important, and thus the birds are often found on the banks of small, clear rivers, having an abundance of undergrowth that is not so dense at ground level as to impair their freedom of movement. The birds also are sometimes found in or near rice fields, mustard, or other cultivated fields. In altitudinal distribution they extend locally up to about 1500 m elevation, and are apparently more sensitive to cold weather than is the Indian peafowl.

There are no estimates of population densities.

*Competitors and predators*

There is no overlap between this species and the Indian peafowl, its most likely serious competitor.

Beebe (1918–1922) considered that civet cats are a likely constant menace, and noticed finding the half-eaten body of a male with leopard tracks around it. Pythons were also mentioned as possible predators.

## General biology

### *Food and foraging behaviour*

Beebe (1918–1922) found the crops of these birds to have an abundance of termites, which he considered their major source of animal foods, as well as berries, grass seeds, peppers, flower petals, crickets, grasshoppers, and small moths.

### *Movements or migrations*

There is little information on this subject, although Beebe (1918–1922) reported that groups of peafowl are extremely sedentary, often occurring in the same area of jungle month after month, feeding in various places, but roosting and drinking with extreme regularity.

### *Daily activities and sociality*

Beebe (1918–1922) observed that the birds came regularly each morning to a river, where they would spend about half an hour preening and drinking. After leaving the river in early morning, one group of birds would go either to a large colony of termite mounds, or to a steep valley where they would disappear and feed for some hours. Toward noon the birds would often rest on a hidden sandbar, usually sleeping or preening, and sometimes drinking and feeding. Late in the afternoon the birds would typically return to the river, where they would sometimes stay until dark. Roosting is done in jungle trees that are typically tall and dead, and the birds will reach these sites by flying first into a neighbouring tree and then to the top of another, from which they finally fly to their roost. Sometimes four or five will roost in a single tree, and rarely as many as seven. In more open jungle lower trees may be used, and these are typically ones that have smooth bark and no branches for some distance above ground, seemingly as antipredator security.

## Social behaviour

### *Mating system and territoriality*

All authorities are agreed that this is a polygynous species, with males typically having harems of up to four or five females. It is likely that the males are territorial during the breeding season, but there is no real information on spacing. It is not known whether the male's loud call serves as a territorial

proclamation, although this would seem probable. Beebe (1918–1922) stated that the calls of this and the Indian peafowl are hard to distinguish, and that a male green will sometimes call in response to a male Indian peafowl's cry.

### *Voice and display*

The male's call is a very loud, penetrating *aow-awo*, or *waaaa-ak!*, repeated several times, and uttered with the neck well stretched and the bill somewhat raised. A second call is also uttered, which is a more subdued but still penetrating call, of several rapidly repeated notes (Beebe 1918–1922). This, or a similar call, sounding like *tak-tak-ker-r-r-oo-oo*, was uttered by a bird walking about in search of a companion that had been shot (Ali and Ripley 1978).

The postural display of this species is almost identical to that of the Indian peafowl. Copulation has been observed to occur when a female quietly approached a displaying male, which uttered a loud scream on seeing her, rushed toward her with drooping wings, and copulated while holding her down with his beak (Ali and Ripley 1978).

## Reproductive biology

### *Breeding season and nesting*

In the Indian region the major breeding season is from January to April, but breeding from July to September has also been reported (Ali and Ripley 1978). On the Malay Peninsula (Pahang area) the breeding season seems to be associated with the wet monsoon from November to May, with the birds in full feather during January and February, and losing their trains by June or July (Medway and Wells 1976). In Java, the birds are in perfect plumage from June to August, at the start of the east monsoon, and they moult in October and November (Beebe 1918–1922). Hoogerwerf (1949) indicated that nesting on Java occurs from August to October, with the largest number of reported clutches in August.

The nests are constructed on the ground, usually in well protected locations with good visibility for approaching danger. The clutch-size in natural conditions seems to vary from three to six eggs, with up to eight eggs reported under conditions of captivity (Beebe 1918–1922). Hoogerwerf (1949) said that the clutch is usually only three or four eggs. Baker (1930) reported a nest in a hollow at the buttressed base of an enormous cotton tree (*Bombax?*), situated under a dense thicket of thorny bushes that was almost impossible to penetrate.

### *Incubation and brooding*

Incubation is by the female alone, and requires 26–28 days. It has been suggested that in some areas



two broods may perhaps be raised in a year, although this seems unproven (Baker 1928).

#### *Growth and development of the young*

The rearing conditions and requirements for the chicks of this species are apparently much the same as occur in the Indian peafowl, although rather little has been written on the subject. In one case it was noted that a 14-day old chick was able to fly up to the roof of a small house, and by 23 days after hatching the crest is already noticeable. Body feathering is apparent at a month of age, and when two and a half months old iridescent colours begin to appear. The young may begin displaying when only a month and a half old (Ali and Ripley 1978). Like the argus and peacock pheasants, the young tend to hide under their mother's tail while very young, and begin to perch on elevated sites at an early age. Sexual maturity is attained by the third year of life.

#### **Evolutionary history and relationships**

The Indian and green peafowl are certainly close relatives, as indicated by the ease of hybridizing them in captivity and the full fertility of the resulting offspring. One hybrid combination (the 'Spauld-

ing's peafowl') has been bred for many generations and now appears to be fixed (Delacour 1977). Certainly the two forms are good species, but they represent an obvious superspecies.

#### **Status and conservation outlook**

This species is now considered 'vulnerable' by the ICBP (King 1981). The Javan population is now limited to Udjong Kulon (estimated less than 50 birds in 1965) and Baluran (about 200 birds at the same time). Small populations have also been noted on the islands of Pucang (off Udjong Kulon), Panaitan (Sunda Strait), and perhaps on Terutao Island (west of Thailand). The species is extirpated, or nearly so, from peninsular Malaysia and Assam. Fair numbers may still exist in north-east and north-west Thailand, but its status in Burma is uncertain, and it was already becoming scarce by 1942 (King 1981). The species is protected in both Malaysia and Thailand, and at least two protected areas, Ujung Lulong National Park and Baluron National Park in Java, have known populations of the species (King 1981; Sumardja 1981). A park has also been established on Terutao Island, which may also support this species.

## 17 · Genus *Afropavo* Chapin 1936

The Congo peacock is a medium-sized tropical pheasant in which sexual dimorphism is slight, and with both sexes exhibiting iridescent plumage and crests. A large area of bluish to reddish skin is present on the sides of the face and upper neck, and in males there is a tuft of white bristles in addition to softer black crest feathers. The wing is rounded, with the tenth primary the shortest, and the fourth to sixth the longest. The tail is composed of 18 rectrices and is flat and rounded, and is only partially covered by upper tail-coverts. In both sexes these coverts as well as most of the mantle feathers are iridescent green, and in males the tail and most of the other body feathers are also iridescent, while in females they are brownish. The tarsus is relatively long and stout, and is spurred in both sexes. A single species is recognized.

### CONGO PEACOCK

*Afropavo congensis* Chapin 1936

Other vernacular names: none in general English use; paon du Congo (French); Kongopfau (German).

#### *Distribution of species*

Rain forests of the east-central Congo Basin, from east of Boende on the Tshuapa River in the west, eastward to the base of the mountain ridge to the west of Lakes Edward and Kivu. In the north reaches the lower Aruwimi River between Basoko and Banalia, and in the south the vicinity of Lusambo. Limited to virgin forests between 1200 and 5000 ft. See map 24.



**Map 24.** General African range (left) and specific locality records (right) of Congo peacock. The limits of the Congo Basin equatorial rainforest are also indicated by a broken line.



*Distribution of subspecies*

None recognized.

**Measurements**

Verheyen (1965) reported that males have wing lengths of 306–315 mm and tail lengths of 206–240 mm, while females have wing lengths of 270–295 mm and tail lengths of 169–205 mm. Two males weighed 1361 and 1475 g, and two females weighed 1135 and 1154 g (D. Rimlinger, *in litt.*). The eggs average  $59 \times 47$  mm, and have an estimated fresh weight of 71.9 g.

**Description (after Delacour 1977)***Male*

Head covered with velvety black feathers; narrow black crest about 35 mm long; tuft of white bristles about 90 mm long, sometimes soiled buffy; feathers of upper back and upper breast black with broad violet-blue borders; mantle, back and rump dark bronzy green; a few long upper tail-coverts with a violet-blue fringe; lesser wing-coverts dark green with a broad bright blue border and a subterminal bright green band; rest of wing black with a greenish blue gloss and a narrow green outer web and a broad disintegrated violet-blue fringe; underparts dark green, the feathers brownish black at the base fringed with blue on the breast and with green on the flanks and thighs; abdomen and under tail-coverts dull black. Iris dark brown; naked skin of the face bluish grey; of the neck bright red; bill light bluish grey, the cere dusky; legs bluish grey, with whitish spurs.

*Female*

No tuft of bristles on the head; crown and crest rufous chestnut; cheeks, nape, and hindneck more thickly feathered than in the male, also rufous chestnut as are the underparts, the feathers showing dark brown barring and mottling on the sides, flanks, lower breast, thighs, and under tail-coverts; abdomen dull black; mantle, back, scapulars, wing-coverts, and tertiaries appearing light metallic green barred with buffy fulvous, the feathers being blackish brown with U-shaped buffy fulvous bars and a broad disintegrated green fringe; secondaries and primaries fulvous chestnut with broad black bars and spots; upper tail-coverts long, soft and disintegrated, black barred with fulvous and with a broad green tip, itself with a fulvous bar; rectrices fulvous chestnut with large black bars and spots and a broad green tip. Iris brown; naked skin of the face greyish brown, of the neck red; bill dull grey washed with olive; legs grey, usually with spurs.

*Immature male*

Duller, the back tinged with brown, the upper breast, upper back and lesser wing-coverts with narrow violet-blue borders, the lower breast and flanks almost entirely dull black; the white tuft of head bristles short, spurs lacking. The adult plumage is completed by the second year.

*Juvenile*

The first plumage is mottled cinnamon and black all over. At the first moult, bronzy green feathers appear on the upper back of the male, and also on the wing-coverts. The young birds soon appear much like the adults, but are duller, with a few brownish crest feathers. The head is blackish grey on the crown and nape, with the sides and the throat remaining buffy fawn. The last mottled cinnamon feathers to be replaced are the primaries and secondaries. Males begin to attain their colour by about three months.

**Identification***In the field* (23–28 in.)

Limited to the lowland forests of the Congo Basin, this species is unlikely to be confused with any other. Both sexes have iridescent green upperparts, bare pink skin on the foreneck, and erect thin crests somewhat similar in shape to those of the green peafowl. Calls are a complex gobbling, hooting sequence of notes that may be repeated as many as 20 or 30 times.

*In the hand*

The peafowl-like shape and appearance of this species, but with adults lacking an elongated train of tail-coverts and having no ocelli, provide for easy identification. The adults are smaller than typical peafowl, and have a wing length no greater than 330 mm.

**Ecology***Habitats and population density*

This species is limited to the tropical rain-forest area of the Congo Basin, at altitudes of from 100 to 1200 m. Cordier (1949) believed that the birds require semi-dry forest, avoiding lowland areas, and tend to occur where certain favourite wild fruits are to be found.

There are no estimates of population densities, which from all accounts would appear to be extremely low.

*Competitors and predators*

Nothing is known with certainty about these topics in wild birds.

**General biology***Food and foraging behaviour*

Evidently this is a rather omnivorous species, eating a variety of seeds, fruits, and insects. Among the foods that have been found in their crops or gizzards are the drupes of a common broad-leaved tree (*Celtis ituriensis*), aquatic insects, and termites. Termite larvae have also been found, suggesting that the birds probably dig into termite mounds in the manner of many tropical pheasants (Verheyen 1965).

*Movements or migrations*

Nothing is known of this subject in the wild.

*Daily activities and sociality*

Little can be said of this with certainty, but the birds are apparently non-social and are more likely to occur in pairs than in harems or other large congregations.

**Social behaviour***Mating system and territoriality*

In this species, unlike the other peafowl, the male is believed to form a monogamous pair bond with a female and remain with her through the entire breeding period (Ridley 1984). David Rimlinger (*in litt.*) stated that in his experience it was his impression that the bond is stronger than in any other pheasants except the eared pheasants. This conclusion is based on observations in captivity, but there seems little doubt that at least under such conditions a prolonged and individualized attachment between the sexes is present. The relatively small degree of sexual dimorphism in body weight and in plumage development would also support this conclusion.

Nothing is known of the degree of territoriality, if any, in this species.

*Voice and display*

The calls of this species have been variously described. By Chapin's (1938) description the common call can be written as *rro-ho-ho-o-a*, followed by a *gowe-gowah*, that many birds may reiterate. The second syllable of the *gowe* portion is more accented or higher-pitched than the first, and from the occasional irregularity of the timing of these notes it may be possible that two birds may be answering one another. These notes may be repeated 20–30 times, sometimes with short interruptions. The

naturalist Charles Cordier described the first portion of the call as that of the male, *ko-ko-wa*, and the female's response as a higher pitched *hej-hoh, hej-hoh*, forming a kind of duet. An African native's interpretation of the call was *wai-wai-ekalu-eko-pawola* (Verheyen 1965). It is known that captive males will often call early in the morning, as the head with open bill is brought back down to the small of the back as the gobbling-hooting call is uttered. Other males have been known to join in, calling alternately (Roles 1981). When alarmed, the birds crane the neck and utter a clucking note (Jeggo 1972). The birds also utter many low calls while eating, displaying, or simple walking, which perhaps serve as contact calls between paired birds. Some of these calls are very similar to the vocalizations of the Indian peafowl (David Rimlinger, *in litt.*). Some calling is said to occur at night as well, presumably while the birds are on their roosts, as in typical peafowl.

The displays of the species are not yet well understood, but have been described by Jeggo (1972). He stated that the male has two major courtship postures, one frontal and one lateral. (Fig. 45). In the frontal posture the male raises his head, emits a low and drawn-out note, slightly 'inflates' the bare skin of the throat, and then bows while uttering a series of shorter and rapid notes, while the tail is raised and fanned, and the wings are drooped and tilted slightly outward, so that the primaries are visible from the front. The posture slightly resembles the frontal display of the Indian peafowl, lacking of course the train of tail-coverts. This posture may be assumed when the male is on a perch or while on the ground as he is facing the female. The female will sometimes respond with a threat-like display, in which she holds her head high, with her tail raised and fanned, and her wings drooped, and thus strut toward the male. During lateral display, the male begins with the same call as used during frontal display, but his head is lowered and extended anteriorly in a straight line with the back while the tail is spread and fanned toward the side nearer the female. The wing of the same side is spread and lowered, whilst the other is held in and arched up, causing the bird to appear tilted toward one side. While in this posture the bird moves around the female. Tidbitting behaviour also occurs; in this the male will hold a morsel in his beak with his head lowered, then call the female up to take it. Similar behaviour is performed by both sexes when feeding chicks. This retention of true tidbitting behaviour as well as a lateral display in *Afropavo* is especially interesting in view of their absence in *Pavo*, and suggest that *Pavo* is behaviourally as well as structurally the more specialized genus.





Fig. 45. Postures of male Congo peacock, including frontal display as seen from the side (A) and the front (B), lateral display as seen from in front (C) and the side (D), and threat display as seen from the side (E) and in front (F). In part after sketches by Jeggo (1972).

Both sexes exhibit aggressive behaviour in the same manner, by assuming a posture much like that of the strutting display, but with a varying amount of wing-lowering and wing-spreading. In intense aggressive display, as when defending a nest or brood, the female may lower her wings to the point that the carpal joints almost reach the ground (Jeggo 1972). David Rimlinger (*in litt.*) regarded the courtship and threat display as the same or very similar, and noted that the male usually spreads his wings at the female or a human at the most intense moment

of posturing only. When the wings are spread, together with the tail, a full half-circle of iridescent colour is visible when the male is viewed directly from the front.

### Reproductive biology

#### *Breeding season and nesting*

Nothing definite is known of the breeding season in the wild, and no nests have been described from

nature. However, based on captive observations it is probable that the species normally nests in trees. It constructs no true nest, but rather lays its eggs on a flat surface such as a slightly concave platform on a large tree limb, preferably less than 1.5 m above the ground. However, it has also been known to lay its eggs on the substrate surface. The eggs are apparently laid at three-day intervals. Typically only two or three eggs are laid, although on at least two occasions clutches of four eggs have been reported (Verheyen 1965). Between 1964 and 1973 a total of 554 eggs in 179 clutches were produced at the Antwerp Zoo, or an average clutch of 3.09 eggs per clutch, and an average of 2.2 clutches per pair per year (Lovel 1976). Up to five or six clutches have been produced by some females in a single year (Van den bergh 1975).

#### *Incubation and brooding*

The incubation period is from 27–28 days, based on observations at Rotterdam Zoo, whilst at various other zoos the duration has ranged from 25 to 27 days. The female remains completely motionless as she incubates, lowering her head over her back and becoming very inconspicuous. The male may spend long periods sitting beside the nest site, but never attempts to incubate. Females leave their incubation for only short periods, to feed and drink (Roles 1981).

#### *Growth and development of the young*

The young chicks remain in the nest with their mother for up to two days, after which she leaves the nest and they flutter down to the ground as well. Both sexes subsequently brood the young chicks, and call to them to take bits of food from their beaks. During their first week the chicks eat almost nothing but insects and other animal foods. During the first night that they are out of the nest the chicks may be brooded on the ground by the male, while the female roosts on the nest. After that the young are brooded under the wings of the mother while she sits on a low perch. Soon the young are able to reach perches 2m or more in height, half-flying, half-running to reach it. By the sixth day the young can fly up to a height of 5 m, and after a month they brood close to, but not under the wings of, their mother (Verheyen 1965). Adult plumage is attained in the second year of life. Females become fertile at one year, but males only at 18 months. In captivity, a male can be housed with more than one female, but is apparently interested in only one of them, while the other hen tends to be persecuted by the chosen female (Van der bergh 1975).

### **Evolutionary history and relationships**

The relationships of this species have attracted a good deal of attention and controversy, as summarized by Verheyen (1965). The surprisingly similar appearance of *Afropavo* to a hybrid between a guineafowl and peafowl, as well as some skeletal similarities with guineafowl, have led some people such as Verheyen (1956) to suggest that it may be a connecting form between these two groups. However, the major morphological contribution to its relationship has been provided by Lowe (1939), who did a detailed anatomical study of its bones, muscles, and feather tracts, as well as its distinctive plumage pattern. He judged that the plumage pattern of the male was clearly a primitive one, and that in its tail-coverts could be detected the adumbration pattern of the pavonine ocellations, which can also be seen in the sequence of peacock pheasants beginning with the bronze-tailed, proceeding through the Rothschild's and on to the typical *Polyplectron* forms. He judged that *Afropavo* may indeed come close to an ancestral peacock-like type that presumably occurred during Miocene times in southern Europe. It may have been driven south during the Pleistocene to a last retreat in the Congo forests, thus having been completely isolated from the other Asian pheasants. Various other recent studies have suggested that *Afropavo* is a relatively isolated form, with only remote affinities to *Pavo* (Gysels and Rabaye 1962; Hulselmans 1962). However, the most recent study by de Boer and van Bockstaele (1981) has tended to confirm Chapin's original view, that *Afropavo* and *Pavo* are indeed more closely related to one another than to any other Galliformes. Interestingly, however, an affinity with the guineafowl group was also suggested by their data. I believe that *Afropavo* is indeed a primitive peafowl, perhaps not very different from the ancestral type that produced the modern *Pavo*, and one that has never acquired (rather than having secondarily lost) the elaborate male ocellation pattern, while at the same time having retained the generalized male pheasant display features (tidbitting and lateral display) that *Pavo* has subsequently lost.

### **Status and conservation outlook**

Lovel (1976) has summarized the captive status of this species, which is very slowly becoming established in captivity. In the wild state, its current status is essentially unknown, although it is likely that forest clearing and hunting may have reduced its numbers. The new Salonga National Park in Zaire, which covers some 3.6 million ha, is in the middle of this species' range, and thus a degree of protection has been accorded it.



# Appendix 1

## Derivations of scientific and vernacular names of pheasants

*Afropavo*: Latin, an African peacock.

*congensis*: of the Congo River.

*Argusianus*: Latin, adjective from *Argus*, the original preoccupied name given the bird.

*argus*: in reference to the mythological shepherd with a hundred eyes.

*grayi*: after G. R. Gray (1808–1872), one-time curator of birds of the British Museum.

*Catreus*: Greek, referring to a peacock-like bird.

*wallichii*: after Dr N. W. Wallich (1786–1854), Danish botanist and one-time superintendent of the Calcutta Botanical Garden. The vernacular name cheer is from the Nepalese *kahir*, or *chirir*, an onomatopoeic name.

*Chrysolophus*: from the Greek *chryseos*, golden, and *lophos*, crest.

*amherstiae*: after Sarah, Countess of Amherst (1762–1838).

*pictus*: Latin, painted or adorned.

*Crossoptilon*: from the Greek *krossotos*, fringed, and *ptilon*, down or feathers, referring to the specialized tail feathers.

*auritum*: Latin, eared.

*mantchuricum*: of Manchuria.

*tibetanum*: of Tibet.

*Gallus*: Latin, meaning a cock. The term gallinaceous is derived from *gallina*, hen.

*lafayetti*: after Marquese de Lafayette (1757–1834), French general and statesman.

*sonnerati*: after P. Sonnerat (1745–1814), French naturalist who discovered the species.

*varius*: Latin, variegated, in reference to the plumage pattern.

*Ithagenis*: Greek, legitimate, of a true race.

*cruentus*: Latin, stained with blood, in reference to the reddish plumage.

*Lophophorus*: from the Greek *lophos*, crest, and *phoros*, to bear.

*impeyanus*: after Lady Impey, wife of Sir Elijah Impey, first governor of Bengal. The vernacular name is derived from the central Himalayan native name *moonal*.

*lhuysii*: after E. Drouyn de Lhuys (1805–1881), president in 1866 of the Soci  t   Imperiale d'Acclimations.

*sclateri*: after Dr P. L. Sclater (1829–1913), English ornithologist.

*Lophura*: from the Greek, *lophos*, crested, and *ura*, tail.

*bulweri*: after H. E. G. Bulwer (1834–1914), Governor of Lauban.

*edwardsi*: after Prof. A. Milne-Edwards (1835–1900), famous French naturalist, and Director of the National History Museum in Paris.

*erythrothalma*: from the Greek *erythros*, reddish, and

*ophthalmos*, eye. This species is sometimes placed in the genus *Acomus*, meaning crestless.

*ignita*: from the Latin *ignis*, fire, in reference to the back and abdominal plumage.

*imperialis*: Latin, imperial.

*inornata*: Latin, non-ornamental.

*leucomelana*: from the Greek *leukos*, white, and *melas*, black. The vernacular name kaleege is derived from the native Nepalese name *kalich* or *kalij*. This species is sometimes placed in the genus *Gennaeus*, meaning genuine or good.

*nycthemera*: from the Greek, *nyctos*, night, and *hemera*, day, in reference to its black and white plumage pattern.

*swinhoei*: after Robert Swinhoe (1836–1877), discoverer of the species, and one-time British Consul in Formosa.

*Pavo*: Latin, a peafowl.

*cristatus*: Latin, crested.

*muticus*: Latin, docked or curtailed.

*Phasianus*: from the Greek *phasianos*, a pheasant or bird from Phasis (a river in Colchis).

*colchicus*: of Colchis, now Mingrelia, an area in western Trans-Causasia.

*versicolor*: Latin, many-coloured.

*Polyplectron*: from the Greek *poly*, many, and *plectrum*, something to strike with.

*bicalcaratum*: from the Latin *bi*, two, and *calcar*, a spur; two-spurred.

*chalcidurum*: from the Greek *chalkos*, copper, and *oura*, the tail.

*emphanum*: from the Greek *en*, in, and *phanos*, brightness or light.

*germaini*: after L. Germain (1827–1927?), who sent the first specimens from China.

*inopinatus*: Latin, unexpected. The generic name *Chalcidurus*, sometimes applied to this species, is explained above.

*malaccense*: of Malacca.

*schleiermacheri*: after a Herr Schleiermacher, director of the Hessian Museum in 1877.

*Pucrasia*: a Latinized onomatopoeic name.

*macrolopha*: from the Greek *makros*, long, and *lophos*, crested. The vernacular name koklass is from the native onomatopoeic name *kokla*, *koklass*, or *phocrass*, from which the generic name *Pucrasia* is also derived.

*Rheinartia*: after a Captain Rheinard, of the French army in Annam in 1880–1883, who sent the first specimen to Paris.

*ocellata*: Latin, ocellated.

*nigrescens*: Latin, dusky.

*Syrmaticus*: Latin, dragging or trailing behind; from the Latin *syrmia*, a robe with a train, in reference to the long tail.

*elliotti*: after D. G. Elliot (1835–1915), American ornithologist.

*humiae*: after Mary Hume (?–1890), wife of Allen Hume, English ornithologist.

*mikado*: referring to the Emperor of Japan.

*reevesi*: after J. Reeves (1774–1856), English businessman who first brought living specimens to England in 1831.

*soemmerringi*: after Dr S. T. v. Soemmering (1755–1830), German professor.

*Tragopan*: from the Greek *tragos*, a goat, and *Pan*, the

mythical Greek god; literally goat-Pan, in reference to the male's 'horns'.

*blythi*: after Edward Blyth (1810–1873), English naturalist and one-time curator of the Calcutta Museum.

*caboti*: after Dr Samuel Cabot (1815–1885), American ornithologist.

*melanocephalus*: from the Greek *melas*, black, and *kephale*, a head.

*satyra*: satyr-like; a satyr was a Greek and Roman semi-deity, with the horns and hind limbs of a goat.

*temminckii*: after G. J. Temminck (1775–1858), Dutch ornithologist.



# Appendix 2

## Distributional check-list of francolins, partridges and Old World quails (tribe *Perdicini*)

### Genus *Lerwa*

*L. lerwa*: snow partridge. Himalayas from Afghanistan to western China.

### Genus *Ammoperdix* (sand partridges)

*A. griseogularis*: see-see partridge. Turkey and Iraq to western India and southern Russia. Includes subspecies *peraticus*.

*A. heyi*: sand partridge. Nile Valley to Sinai Peninsula. Includes subspecies *nicolii*, *cholmleyi* and *intermedia*.

### Genus *Tetra gallus* (snowcocks)

*T. caucasicus*: Caucasian snowcock. Alpine zone of Caucasus Mountains.

*T. caspius*: Caspian snowcock. Alpine zone of mountains from eastern Turkey to Armenia and Transcaspia. Includes subspecies *semenowtianschanskii*.

*T. tibetanus*: Tibetan snowcock. Alpine zone of eastern Pamirs to Kansu, Kashmir, and the Tibetan Himalayas. Includes subspecies *tschimenensis*, *centralis*, *przewalskii*, *henrici*, and *aquilonifer*.

*T. altaicus*: Altai snowcock. Alpine zone of Altai and Sajon Mountains of central Asia. Includes subspecies *orientalis*.

*T. himalyensis*: Himalayan snowcock. Alpine zone of Himalayas from Afghanistan to Nepal, Tsinghai and Kansu. Includes subspecies *sewerzowi*, *bendi*, *grombzevskii* and *koslowi*. Locally introduced into western USA (Nevada).

### Genus *Tetra ophasis* (monal partridges)

*T. obscurus*: Verreaux's monal partridge. High mountains from eastern Tibet to western China, west to long. 100° E.

*T. szechenyi*: Szechenyi's monal partridge. High mountains of eastern Tibet and western China, east to long. 104° E. Possibly conspecific with *obscurus*.

### Genus *Alectoris* (rock partridges)

*A. graeca*: rock partridge. Alps from France and Italy to Austria and Bulgaria. Includes subspecies *saxatilis* and *whitakeri*; other subspecies referred to *chukar* (Cramp and Simmons 1980).

*A. chukar*: chukar partridge. Widespread from the Balkan Peninsula east to southern China; also introduced in Hawaii and western North America. Includes subspecies *sinaica*, *daghestanica*, *caucasica*, *werae*, *koroviakovi*, *shestoperovi*, *subpallida*, *falki*, *dzungarica*, *fallax*, *pallida*, *pallenscens*, *obscurata*, *kleini*, *cypristes* (including *scotti*), *kurdestanica*, *potanini*, and *pubescens*.

*A. magna*: Przewalski's rock partridge. From eastern Tibet to western Kansu. Sometimes considered conspecific with *graeca*, but regarded as distinct by Vaurie (1965).

*A. philbyi*: Philby's rock partridge. Endemic from south-west Arabia to northern Yemen.

*A. barbara*: Barbary partridge. Canary Islands; Sardinia;

North Africa to north-west Egypt. Includes subspecies *therease*, *koenigi*, *spatzi* and *barbata*.

*A. rufa*: red-legged partridge. France to the Iberian Peninsula; Corsica; Italy. Also introduced in Great Britain and locally in central Europe. Introduced but not yet established in North America.

*A. melanocephala*: Arabian partridge. From Arabia to the Aden Protectorate. Includes subspecies *guichardi*.

### Genus *Anurophasis*

*A. monorthonyx*: snow mountain quail. Endemic in the Oranje (Snow) Mountains of New Guinea. Possibly a close relative of *Coturnix* (Olson 1980).

### Genus *Francolinus* (francolins, including *Pternistis*) (after Hall 1963).

#### 1. Spotted group

*F. francolinus*: black francolin. Asia Minor to Iraq, Iran, and India to Assam. Introduced locally in USA (Louisiana and Florida). Includes subspecies *billypaynei*, *arabistanicus*, *bogdanovi*, *henrici*, *asiae* and *melanonotus*.

*F. pictus*: painted francolin. Widespread in grasslands of Indian subcontinent; Sri Lanka. Includes subspecies *pallidus* and *watsoni*.

*F. pintadeanus*: Chinese francolin. Widespread throughout south-east Asia. Includes subspecies *phayrei*.

#### 2. Bare-throated group

*F. afer*: bare-throated francolin. Widespread in Africa south of the Congo. Includes subspecies *nyanzae*, *harterti*, *cranchii*, *leucoparaeus*, *bohmi*, *itigi*, *intercedens*, *castaneiventer*, *loangwae*, *benguellensis*, *punctulatus*, *cunenensis*, *humboldtii*, *swynnertoni*, *lehmanni*, *krebsi*, and *notatus*.

*F. swainsonii*: Swainson's francolin. Namibia to Zimbabwe, Zambia and Mozambique. Includes subspecies *gilli*, *damarensis* and *chobiensis*.

*F. rufopictus*: grey-breasted francolin. Tanzania south of Lake Victoria.

*F. leucoscepus*: yellow-necked francolin. Somalia, Ethiopia, Kenya, Uganda and Tanzania. Includes subspecies *muhammedbenabdullah* and *infuscatus*.

#### 3. Montane group

*F. erckelii*: Erckel's francolin. Eritrea to Egyptian Sudan. Introduced on Hawaiian Islands. Includes subspecies *pentoni*.

*F. ochropectus*: pale-bellied (Tadjoura) francolin. Endemic in juniper forests of Djibouti (rare species).

*F. castaneicollis*: chestnut-naped francolin, Ethiopia to Somalia. Includes subspecies *ogoensis*, *bottegi*, *kaffanus*, *gofanus* and *atrifrons*.

*F. jacksoni*: Jackson's francolin. Montane forests of Kenya. Includes subspecies *pollenorum* and *gurae*.

*F. nobilis*: handsome francolin. Montane forests of eastern Zaire and western Uganda. Includes subspecies *chapini*.

- F. camerunensis*: Cameroon Mountain francolin. Endemic on Cameroon Mountain.
- F. swierstrai*: Swierstra's francolin. Endemic to central Angola, where possibly endangered.
4. *Scaly group*
- F. achantensis*: Ahanta francolin. Guinea to Nigeria and Gambia.
- F. squamatus*: scaly francolin. Widespread in central Africa south of the Sahara. Includes subspecies *schuetti*, *zappeyi*, *tetraoninus*, *maranensis*, *usambarae*, *uzungwensis*, and *doni*.
- F. griseostriatus*: grey-striped francolin. Endemic to northern Angola, where rare and local.
5. *Vermiculated group*
- F. bicalcaratus*: double-spurred francolin. From western Morocco and Senegal to Cameroon. Includes subspecies *ayesha*, *thornei*, *adamauae* and *ogilviegranti*.
- F. icterorhynchus*: yellow-billed francolin. From Central African Republic to Zaire and the Sudan and Uganda. Includes subspecies *dybowskii* and *ugandensis*.
- F. clappertoni*: Clapperton's francolin. From Mali to the Sudan, Uganda, Kenya, and Ethiopia. Includes subspecies *gedgii*, *heuglini*, *sharpii*, *konigseggii*, and *nigrosquamatus*.
- F. hildebrandti*: Hildebrandt's francolin. Zaire to Kenya and Malawi. Includes subspecies *altumi* and *johnstoni*.
- F. natalensis*: Natal francolin. Scrub areas from Zambia to Natal. Includes subspecies *neavei*.
- F. hartlaubi*: Hartlaub's francolin. From Angola to Namibia. Includes subspecies *bradfieldi* and *crypticus*.
- F. harwoodi*: Harwood's francolin. Blue Nile gorge of Ethiopia.
- F. adspersus*: red-billed francolin. From southern Angola to Zambia and Namibia.
- F. capensis*: Cape francolin. Endemic in south-western Cape Province.
6. *Striated group*
- F. sephaena*: crested francolin. Widespread in eastern Africa south of the Sahara, west to Namibia. Includes subspecies *zambesiae*, *granti*, *spilogaster* and *rovuma*.
- F. streptophorus*: ring-necked francolin. Kenya, Uganda, and Tanzania; also in Cameroon.
7. *Red-winged group*
- F. psilolaemus*: montane red-winged francolin. Endemic to mountains of central Ethiopia. Includes subspecies *theresae*, *elgonensis*, and *ellenbecki*.
- F. shelleyi*: Shelley's francolin. Widespread in eastern Africa from Kenya to Malawi. Includes subspecies *uluensis* (including *macarthurii*) and *wheytei*.
- F. africanus*: grey-winged francolin. Limited to the grasslands in the mountains of Transvaal, Orange Free State, and Cape Province; local in Natal mountains.
- F. levalliantoides*: acacia red-winged francolin. Widespread in arid grasslands of Africa from Ethiopia (Eritrea) south to Orange Free State and southern Mozambique. Includes subspecies *kalaharica*, *pallidior*, *jugularis*, *archeri*, *lorti*, and *gutteralis* (the last possibly specifically distinct).
- F. levallantii*: red-winged francolin. Occurs locally from north-west Kenya to the Cape and western Angola. Includes subspecies *kikuyuensis*, *crawshayi*, *benguellensis*, and *clayi*.
- F. finschi*: Finsch's francolin. Endemic in woodlands of western Angola and south-west Zaire.
8. *Red-tailed group*
- F. coqui*: Coqui francolin. Widespread in Africa south of the Sahara, from Mali and Ethiopia south to Botswana and Natal. Includes subspecies *vernayi*, *hoeschianus*, *angolensis*, *kasaicus*, *ruahdae*, *hubbardi*, *thikae*, *maharao*, and *spinetorum*.
- F. albogularis*: white-throated francolin. Western Africa from Senegal to Cameroon. Includes subspecies *buckleyi*, *dewittei* and *meinertzhageni*.
- F. schlegelii*: Schlegel's banded francolin. Southern Central African Republic to south-west Sudan.
9. Not assigned to any group by Hall (1963)
- F. lathamii*: Forest francolin. Sierra Leone to Gabon and north-west Zaire. Includes subspecies *schubotzi*.
- F. nahani*: Nahan's forest francolin. Endemic to Uganda and north-western Zaire.
- F. pondicerianus*: grey francolin. Widespread from eastern Iran across the Indian subcontinent to Assam; Sri Lanka. Includes subspecies *mecranensis*, *interpositus*, and *ceylonensis*. Introduced locally on the Hawaiian Islands, southern Arabia, and islands of Indian Ocean.
- F. gularis*: swamp francolin. Limited to the *terai* of northern India and Nepal east to Assam.
- Genus *Perdix* (typical partridges)
- P. perdix*: grey partridge. Widespread (in part through introductions) throughout most of the Palaearctic from Great Britain to central Asia, and south to Turkey and Lake Balkash. Also widely introduced into North America. Includes subspecies *armoricana*, *sphagnetorum*, *hispaniensis*, *italica*, *lucida*, *robusta*, *arenicola*, *furvescens*, and *canescens*.
- P. dauuricae*: Daurian partridge (= *P. barbata*). Widespread in Asia from central USSR to Manchuria, China, and Mongolia. Includes subspecies *castaneothorax*, *turcomana*, *przewalskii*, and *suschkini*.
- P. hodgsoniae*: Tibetan partridge. Highlands of northern India, adjacent Tibet, Szechwan, and Kansu. Includes subspecies *koslowi*, *sifanica*, and *caraganae*.
- Genus *Rhizothera*
- R. longirostris*: long-billed wood partridge. Malaysia, Sumatra, and Borneo. Includes subspecies *dulitensis*.
- Genus *Margaroperdix*
- M. madagarensis*: Madagascar partridge. Endemic to Madagascar. Probably closely related to *Coturnix* (Olson 1980).
- Genus *Melanoperdix*
- M. nigra*: black wood partridge. Malaysia, Sumatra, and Borneo.
- Genus *Coturnix* (typical quails, including *Excalfactoria* and *Synoicus*).
- C. coturnix*: Eurasian quail. Widespread throughout



Africa and the Palearctic east to north-east Asia and Mongolia. Winters to southern India and South Africa. Subspecies include *conturbans*, *confisa*, *inopinata*, and *africana*.

*C. japonica*: Japanese quail. From Japan and Sakhalin south to Indochina. Introduced on Hawaiian Islands.

*C. coromandelica*: black-breasted quail. India to Burma; Sri Lanka.

*C. delegorguei*: African harlequin quail. Widespread in Africa south of the Sahara; Madagascar. Includes subspecies *histrionica* and *arabica*.

*C. novaezeelandiae*: stubble quail. Australia; Tasmania; extinct on New Zealand (this latter form, *pectoralis*, is sometimes considered a separate species). Includes subspecies *pectoralis*.

*C. ypsilophorus*: brown quail. Malaysia to New Guinea and Australia. Includes subspecies *raaltenii*, *pallidior*, *saturatior*, *lamonti*, *dogwa*, *mafulu*, *castaneus*, *plumbeus*, *cervinus*, *queenslandicus*, and *australis* (the last-named form often being given species distinction).

*C. adansonii*: African blue quail. From Ethiopia to Sierra Leone and eastern Cape Province. Possibly should be considered conspecific with *chinensis*.

*C. chinensis*: Asian blue quail. From India to China and Malaysia; Sunda and Philippine Islands; Australia. Includes subspecies *trinkutensis*, *palmerici*, *lineata*, *lineatula*, *lepida*, *papuensis*, *australis*, and *colletti*.

#### Genus *Perdicula* (bush quails)

*P. asiatica*: jungle bush quail. Dry scrub and bush of India and Sri Lanka. Includes subspecies *vidali* and *ceylonensis*.

*P. argoondah*: rock bush quail. Semi-desert habitats of south-east India. Includes subspecies *meinertzhageni* and *salimalii*.

*P. erythrorhyncha*: painted bush quail. Grassland and scrub of central and south-western India. Includes subspecies *blewitti*.

*P. manipurensis*: Assam bush quail. Moist deciduous habitats of northern India. Includes subspecies *inglisi*.

#### Genus *Arborophila* (hill partridges, including *Tropicoperdix*)

*A. torqueola*: Indian (Common) hill partridge. Dense evergreen forests from northern India and Tibet to Burma and northern Vietnam. Includes subspecies *milardi*, *batemani*, and *griseata*.

*A. rufogularis*: rufous-throated hill partridge. Undergrowth and secondary scrub forest from northern India east to Vietnam. Includes subspecies *intermedia*, *tickelli*, *europa*, *guttata*, and *annamensis*.

*A. atrogularis*: white-cheeked hill partridge. Wet forest undergrowth from Assam to northern Burma and westernmost Yunnan.

*A. crudigularis*: white-throated hill partridge. Endemic on Taiwan.

*A. mandellii*: red-breasted hill partridge. Dense undergrowth of evergreen forests from Sikkim to Assam.

*A. javanica*: Javan hill partridge. Endemic on Java.

*A. brunneopectus*: brown-breasted hill partridge. South-east Asia from Assam to Vietnam; Malayan Peninsula; Sumatra. Includes subspecies *brunneopectus*, *henrici*, *albigula*, *bartelsi*, and *lawuana*.

*A. rufipectus*: Szechwan hill partridge. Endemic in the forests and bamboo thicket hills of western Szechwan.

*A. gingica*: collared hill partridge. Densely wooded forests of southern China (Fukien, Kwangtung, Kwangsi).

*A. davidi*: orange-necked hill partridge. Endemic to southern Vietnam, where rare.

*A. cambodiana*: chestnut-headed hill partridge. Endemic to Cambodia and south-east Thailand. Includes subspecies *diversa*.

*A. orientalis*: bare-throated hill partridge. Malaysia, Sumatra, Java. Includes subspecies *campbelli*, *rolli*, and *sumatrana*.

*A. rubrirostris*: red-billed hill partridge. Endemic on Sumatra.

*A. hyperythra*: rufous-breasted hill partridge. Endemic in north-west Borneo.

*A. ardens*: Hainan hill partridge. Endemic on Hainan Island.

*A. charltonii*: scaly-breasted hill partridge (including *chloropus* and *merlini*). Burma, Thailand, Vietnam, south through Malaysia to Sumatra and Borneo. Includes subspecies *atjahensis*, *tonkinensis*, *graydoni*, *chloropus*, *olivacea*, *cognacqi*, *merlini*, and *vivida*. Up to three species are sometimes recognized in this assemblage.

#### Genus *Caloperdix*

*C. oculea*: ferruginous wood partridge. Forests of Thailand, Malaysia, Sumatra, and Borneo. Includes subspecies *sumatrana* and *borneensis*.

#### Genus *Haematortyx*

*H. sanguiniceps*: crimson-headed wood partridge. Endemic in northern Borneo.

#### Genus *Rollulus*

*R. rouloul*: crested wood partridge. Forests of Thailand, Malaysia, Sumatra, and Borneo.

#### Genus *Ptilopachus*

*P. petrosus*: stone partridge. Rocky habitats from Senegal to Ethiopia and Kenya.

#### Genus *Bambusicola* (bamboo partridges)

*B. fytchii*: mountain bamboo partridge. Moist temperate habitats of western China south to Burma and northern Vietnam.

*B. thoracica*: Chinese bamboo partridge. Hill forests of southern China (Szechwan, Fukien, Kwangsi) and Taiwan.

#### Genus *Galloperdix* (spurfowls)

*G. spadicea*: red spurfowl. Widespread in brushy country and foothills of the Indian subcontinent from western Nepal to south-east India. Includes subspecies *caurina* and *stewarti*.

*G. lunulata*: painted spurfowl. Semi-arid steppes and rocky foothills of the Indian subcontinent south of the Gangetic Plain.

*G. bicalcarata*: Ceylon spurfowl. Endemic to the wetter forests of southern Sri Lanka.

#### Genus *Ophrysia*

*O. superciliosa*: Indian mountain quail. Apparently extinct; once inhabited the western Himalayas of India between 1650 and 2100 m; last reported about 1868.





# Bibliography

- Acton, R. W. (1963). Elliot's pheasant program: an evaluation. *Game Res. Ohio* **2**, 222–34.
- Ali, S. (1962). *The birds of Sikkim*. Oxford University Press, Madras.
- and Ripley, S. D. (1978). *Handbook of birds of India and Pakistan* Vol. 2. Oxford University Press, Oxford.
- Anderson, W. L. (1964). Survival and reproduction of pheasants in southern Illinois. *J. Wild. Manage.* **28**, 254–64.
- Anthony, A. W. (1899). Hybrid grouse. *Auk* **16**, 180–1.
- Asmundson, V. S. and Lorenz, F. W. (1975). Pheasant–turkey hybrids. *Science* **121**, 307–8.
- Baker, C. M. A. (1965). Molecular genetics of avian proteins—IV. The egg white proteins of the golden pheasant *Chrysolophus pictus* L. and the Lady Amherst's pheasant *C. amherstiae* Leadbeater, and their possible evolutionary significance. *Comp. Biochem. Physiol.* **16**, 93–101.
- Baker, E. C. S. (1928). *The fauna of British India, including Ceylon and Burma*. Vol. 5. *Birds*. Taylor and Francis, London.
- (1930). *Game-birds of India, Burma and Ceylon* Vol. 3. John Bale and Son, London.
- (1935). *The nidification of birds of the Indian Empire* Vol. IV. Taylor and Francis, London.
- Banks, E. M. (1956). Social organization in red junglefowl hens (*Gallus gallus* subsp.). *Ecology* **37**, 240–8.
- Baranchev, L. M. (1965). Migrations of Manchurian pheasants to the Amur region. In: *Migrations of birds and mammals* pp. 125–32. Nauka, Moscow (in Russian).
- Baskett, T. S. (1947). Nesting and production of the ring-necked pheasant in north central Iowa. *Ecol. Monogr.* **17**, 1–30.
- Bates, R. S. P. and Lowther, E. H. N. (1952). *Breeding birds of Kashmir*. Oxford University Press, Oxford.
- Baxter, W. L. and Wolfe, C. W. (1973). Life history and ecology of the ring-necked pheasant in Nebraska. Nebraska Game and Parks Commission, Lincoln, 58 pp.
- Beebe, C. W. (1914a). Preliminary pheasant studies. *Zoologica* **1**(15), 261–85.
- (1914b). Revision of the genus *Gennaeus*. *Zoologica* **1**(17), 303–23.
- (1918–22). *A monograph of the pheasants*. Witherby, London.
- (1936). *Pheasants, their lives and homes* (2nd edn). Doubleday Doran, New York.
- Beer, J. V. and Cox, C. (1981). The production of eggs of the cheer pheasant *Catreus wallichi* for re-introduction programs. In *Pheasants in Asia, 1979* (ed. C. Savage) pp. 68–71. World Pheasant Association, Exning, Suffolk.
- Bierens de Hann, J. A. (1926). Die Balz des Argusfasans. *Biol. Zentralblatt* **46**, 428–35.
- Biswas, B. (1960–63). The birds of Nepal. *J. Bombay Nat. Hist. Soc.* **57**, 278–308, 516–46; **58**, 100–34, 441–74, 653–77; **59**, 200–27, 405–29, 807–21; **60**, 178–200, 388–99.
- (1968). The female of Molesworth's tragopan *Tragopan blythi molesworthi* Baker. *J. Bombay Nat. Hist. Soc.* **65**, 782–4.
- Boback, A. W. and Müller-Schwarze, D. (1968). Das Birkhuhn. Neue Brehm Bucherei 397. A Ziemsen, Wittenberg Lutherstadt.
- Boer, L. E. M. de and van Bockstaele, R. (1981). Somatic chromosomes of the congo peafowl (*Afropavo congensis*) and their bearing on the species' affinities. *Condor* **82**, 204–8.
- Bohl, W. H. (1964). A study and review of the Japanese green and the Korean ring-necked pheasant. U.S. Fish and Wildlife Service, Special Scientific Report, Wildlife No. 83.
- Boetticher, H. von (1939). Ueberblick über die Huhnervogel und ihre Verbreitung. *Fol. Zool. Hydrobiol.* **9**, 290–9.
- Boonlerd, A. (1981). Thailand: status of the pheasants. In *Pheasants in Asia, 1979* (ed. C. Savage) pp. 39–42. World Pheasant Association, Exning, Suffolk.
- Brun, R. (1971). Problems of ontogenesis and evolution in the feather pattern formation of the Argus pheasant (*Argusianus argus*). *Rev. Suisse Zool.* **78**, 115–34 (in German, with English summary).
- Bruning, D. (1977). Breeding the Malay peacock pheasant at the New York Zoological Park. *Avic. Mag.* **83**, 61–2.
- (1983). Continued breeding success with Malay peacock pheasants, *Polyplectron malacense malacense*, at the New York Zoological Park. *Wild Pheasant Ass. J.* **8**, 62–8.
- Brush, A. (1967). Haemoglobins of a ring-necked pheasant × junglefowl hybrid. *Condor* **69**, 206.
- Bump, G. and Bohl, W. H. (1961). Red junglefowl and kalij pheasants. U.S. Fish and Wildlife Service, Special Scientific Report, Wildlife No. 62.
- Bura, A. (1967). Das Juvenilgefieder von *Phasianus colchicus* L., ein Beitrag zur Kenntnis dieser Altersstufe des Gefieders. *Rev. Suisse Zool.* **74**, 301–87.
- Burger, G. V. (1966). Observations on aggressive behavior of male ring-necked pheasants in Wisconsin. *J. Wild. Manage.* **30**, 57–64.
- Burtulin, S. A. (1904). On the geographical distribution of the true pheasants (genus *Phasianus sensu stricto*). *Ibis Ser. 8*, **4**, 377–414.
- (1908). Additional notes on the true pheasants (*Phasianus*). *Ibis Ser. 9*, **2**, 570–92.

- Buss, I. O. (1946). Wisconsin pheasant populations. Wisconsin Conservation Dept. Publication 326(A-46), pp. 1-184.
- Carpentier, J., Yealland, J. J., van Bockstaele, R., and van den Bergh, W. (1975). Imperial pheasant hybridization at the Antwerp Zoo. *Int. Zoo Yearb.* **15**, 100-5.
- Catlow, P. (1982). Displays of the Himalayan monal (*Lophophorus impejanus*) in captivity. *Wld Pheasant Ass. J.* **7**, 92-5.
- Chapin, J. C. (1938). The Congo peacock. *Compte Rendu 9 ième Congres Ornithologique Internationale*, Rouen, pp. 101-9.
- Cheng Tso-hsin (1963). *China's economic fauna: birds*. Science Publishing Society, Peking. (Translated by U.S. Dept. of Commerce, Washington, D.C.).
- (1979). On subspecific differentiation of the silver pheasant *Lophura nycthemera*. *Wld Pheasant Ass. J.* **4**, 42-45.
- Tan Yoo-kuang, Lu Tai-chun, Bao Guijun, and Li Fu-lai (1978). *Fauna Sinica, series vertebratica, Aves*. Vol. 4, *Galliformes*. Science Press, Academia Sinica, Peking.
- Clark, C. A., Jr. (1964). Life histories and the evolution of megapodes. *Living Bird* **3**, 149-67.
- Collias, N. E., and Collias, E. C. (1967). A field study of the red junglefowl in north-central India. *Condor* **69**, 360-86.
- Collias, E. C., Hunsaker, D., and Minning, L. (1966). Locality fixation, mobility and social organization within an unconfined population of red junglefowl. *Anim. Behav.* **14**, 550-9.
- and Joos, M. (1953). The spectrographic analysis of sound signals of the domestic fowl. *Behaviour* **5**, 175-88.
- and Saichuae, P. (1967). Ecology of the red junglefowl in Thailand and Malaya with reference to the origin of domestication. *Nat. Hist. Bull. Siam. Soc.* **22**, 89-209.
- and Taber, R. D. (1951). A field study of grouping and social dominance in ring-necked pheasants. *Condor* **52**, 265-75.
- Coomans de Ruiter, L. (1946). Oologische en Biologische Aanteekeningen over eenige Hoendervogels in de Westerafdeeling van Borneo. *Limosa* **19**, 129-40 (in Dutch, with English summary).
- Cordier, C. (1949). Our Belgian Congo expedition comes home. *Anim. Kingdom* **52**, 99-114, 134-36.
- Cottam, C. (1929). The status of the ring-necked pheasant in Utah. *Condor* **13**, 117-23.
- Cracraft, J. (1981). Toward a phylogenetic classification of the Recent birds of the world (class Aves). *Auk* **98**, 681-714.
- Cramp, S. and Simmons, K. E. L., eds. (1980). *The birds of the western Palearctic*, Vol. 2. Oxford University Press, Oxford.
- Crowe, T. M. (1978). The evolution of guinea-fowl (Galliformes, Phasianidae, Numidinae); taxonomy, phylogeny, speciation biogeography. *Ann. S. Afr. Mus.* **76**, 43-136.
- Crozier, G. (1967). Etude de la transferrine des hybrides interspecifiques *Gallus gallus* × *Numida meleagris*. *Ann. Biol. Anim. Biochim. Biophys.* **7**, 73-8.
- Dalke, P. (1937). Food habits of adult pheasants in Michigan based on crop analysis method. *Ecology* **18**, 199-213.
- Danforth, C. H. (1950). Evolution and plumage traits in pheasant hybrids, *Phasianus* × *Chrysolophus*. *Evolution* **4**, 301-15.
- (1958). *Gallus sonnerati* and the domestic fowl. *J. Hered.* **49**, 167-9.
- and Sandness, G. (1939). Behaviour of genes in intergeneric crosses. Effects of two dominant genes on colour in pheasant hybrids. *J. Hered.* **30**, 537-42.
- Davison, G. W. H. (1974). Geographic variation in *Lophophorus sclateri*. *Bull. Br. Ornith. Club* **96**, 163-4.
- (1976). The function of tail and under tail-covert pattern in pheasants. *Ibis* **118**, 123-6.
- (1977). Studies of the crested argus. I. History and problems associated with the species in Malaysia. *Wld Pheasant Ass. J.* **2**, 50-6.
- (1978a). Studies of the crested argus. II. Gunong Rabong 1976. *Wld Pheasant Ass. J.* **3**, 46-53.
- (1978b). Further notes on *Lophophorus sclateri*. *Bull. Br. Ornithol. Club* **98**, 116-8.
- (1979a). The behaviour of the barred-back pheasant (*Syrnaticus humiae* (Hume)). *J. Bombay Nat. Hist. Soc.* **76**, 439-46.
- (1979b). The behaviour and ecology of some Malaysian Galliformes, with special reference to *Argusianus argus* (Phasianidae). Ph.D. dissertation, University of Malaya.
- (1979c). Studies of the crested argus. III. Gunong Rabong, 1977. *Wld Pheasant Ass. J.* **4**, 76-80.
- (1979d). Alleged occurrences of *Rheinartia ocellata* in Sumatra. *Bull. Br. Ornith. Club* **99**, 80-1.
- (1980a). Galliformes and the Gunong Mulu National Park. *Wld Pheasant Ass. J.* **5**, 31-9.
- (1980b). The evolution of the crested argus. *Wld Pheasant Ass. J.* **5**, 91-7.
- (1980c). The type locality of *Rheinartia ocellata nigrescens* Rothschild. *Bull. Br. Ornithol. Club* **100**, 141-3.
- (1981a). Habitat requirements and food supply of the crested fireback. *Wld Pheasant Ass. J.* **6**, 40-52.
- (1981b). Problems of censusing pheasants in tropical rain forest. In *Pheasants in Asia, 1979* (ed. C. Savage) pp. 49-52. World Pheasant Association, Exning, Suffolk.
- (1981c). Status of the pheasants, Malaysia and Indonesia. In *Pheasants in Asia, 1979* (ed. C. Savage) pp. 29-32. World Pheasant Association, Exning, Suffolk.
- (1981d). Sexual selection and the mating system of *Argusianus argus* (Aves: Phasianidae). *Biol. J. Linn. Soc.* **15**, 91-104.
- (1981e). Diet and dispersion of the great argus *Argusianus argus*. *Ibis* **123**, 485-94.



- (1982). Sexual displays of the great argus pheasant *Argusianus argus*. *Z. Tierpsychol.* **58**, 185–202.
- (1983a). The eyes have it: ocelli in a rain-forest pheasant. *Anim. Behav.* **31**, 1037–42.
- (1983b). Behaviour of Malay peacock pheasant, *Polyplectron malacense*. *J. Zool.* **201**, 57–66.
- (1983c). Notes on the extinct *Argusianus bipunctatus* (Wood). *Bull. Br. Ornithol. Club* **103**, 86–8.
- . Recent pheasant surveys in peninsular Malaysia. In *Pheasants In Asia* (ed. F. C. R. Howman). World Pheasant Association, Exning, Suffolk. In press (a).
- . Ecology and behaviour of great argus in suboptimal habitat. In *Pheasants in Asia, 1982* (ed. F. C. R. Howman). World Pheasant Association, Exning, Suffolk. In press (b).
- . Peacock-pheasant display without ocelli. *Indo-Malayan Zoology*. In press (c).
- and Scriven, K. Recent pheasant surveys in peninsular Malaysia. In *Pheasants in Asia, 1982* (ed. F. C. R. Howman). World Pheasant Association, Exning, Suffolk. In press.
- Deignam, H. G. (1945). The birds of northern Thailand. *Bull. U.S. natn. Mus.* **186**, 1–615.
- Delacour, J. (1945). Note on the eared pheasants (*Crossoptilon*). *Zoologica* **80**, 30–45.
- (1948). The subspecies of *Lophura nycthemera*. *Am. Mus. Novit.* **1377**, 1–12.
- (1949). The genus *Lophura*. *Ibis* **91**, 188–200.
- (1977). *The pheasants of the world* (2nd edn). World Pheasant Association and Spur Publications, Hind-head.
- (1978). *Pheasants: their care and breeding*. T. F. H. Publishing, Neptune, NJ.
- and Jabouille, P. (1925). The birds of Quangtri, central Annam, with notes on others from other parts of French Indo-China. *Ibis Ser. 12*, **1**, 209–60.
- Dementiev, G. P., and Gladkov, N. A., eds (1967). *Birds of the Soviet Union* Vol. 4. Israel Programme for Scientific Translations, Jerusalem.
- Denton, V. (1978). Breeding experiences with Rothschild's and Bornean peacock pheasants. (ed. Risser, A. C., Jr., Baptista, L. F., Wylie, S. R., and Gale, N. B.). In *Proceedings of the First International Birds in Captivity Symposium* pp. 318–21. Seattle, Washington.
- Deraniyagala, P. E. P. (1957). Growth, subspeciation and hybridisation in the Ceylon junglefowl. *Spolia Zeylan* **28**, 99–106.
- Domm, L. V. (1927). New experiments on ovariectomy and the problem of sex inversion in the fowl. *J. Exp. Zool.* **48**, 385–416.
- Dumke, R. T. and Pils, C. M. (1973). Mortality of radio-tagged pheasants on the Waterloo Wildlife Area. Wisconsin Dept. of Natural Resources, Technical Bulletin No. 72, pp. 1–52.
- and — (1979). Renesting and dynamics of nest site selection by Wisconsin pheasants. *J. Wildl. Manage.* **43**, 705–16.
- Durrer, H. (1965). Bau und Bildung der Auffeder des Pfau (*Pavo cristatus* L.). *Rev. Suisse Zool.* **72**, 263–411.
- Edminster, F. C. (1954). *American game birds of field and forest*. Charles Scribners Sons, New York.
- Edwards, W. R., Mikolay, P. J., and Leitch, E. A. (1964). Implications from winter-spring weights of pheasants. *J. Wildl. Manage.* **28**, 290–7.
- Einarsen, A. S. (1945). Some factors affecting ring-necked pheasant density. *Murrelet* **26**, 2–9, 39–44.
- Elliot, D. G. (1870–72). *A monograph of the Phasianidae, or family of the pheasants*. 2 vols. Published by the author, New York.
- Errington, P. L. and Hamerstrom, F. N. (1937). The evaluation of nesting losses and juvenile mortality of the ring-necked pheasant. *J. Wildl. Manage.* **1**, 3–20.
- Etchécopar, R. D., and Hübner, F. (1978). *Les oiseaux de Chine, Non-passereaux*. N. Boubée, Paris.
- Etter, S. L., Warnock, J. E., and Joselyn, G. B. (1970). Modified wing molt criteria for estimating the ages of wild juvenile pheasants. *J. Wildl. Manage.* **34**, 620–26.
- Felix, F. (1964). Ohrfasen. Neue Brehm Bucherei 339. A. Ziemsen, Wittenberg Lutherstadt.
- Ferrel, C. M., Twining, H., and Herkenbaum, N. B. (1949). Food habits of the ring-necked pheasant (*Phasianus colchicus*) in the Sacramento Valley, California. *Calif. Fish Game* **35**, 51–69.
- Fischer, G. L. (1975). The behaviour of chickens. In *The behaviour of domestic animals* (ed. E. S. E. Hafez) pp. 454–89 (3rd edn). Williams and Wilkins, Baltimore.
- Fleming, R. L., Jr. (1967). The birds of Mussoori, U.P., India; a distributional and ecological study. Ph.D. dissertation, Michigan State University, East Lansing.
- Fleming, R. L., Sr., Fleming, R. L., Jr., and Bangdel, L. S. (1976). *Birds of Nepal, with reference to Kashmir and Sikkim*. Published by the authors, Katmandu, Nepal.
- Flieg, G. M. (1973). Breeding the peacock pheasants. *Avic. Mag.* **79**, 216–18.
- Fried, L. A. (1940). The food habits of the ring-necked pheasant in Minnesota. *J. Wildl. Manage.* **4**, 27–36.
- Garson, P. J. (1983). The cheer pheasant *Catreus wallichii* in Himachal Pradesh. *Wld Pheasant Ass. J.* **8**, 29–39.
- Gaston, A. J. (1980). Census techniques for Himalayan pheasants including notes on individual species. *Wld Pheasant Ass. J.* **5**, 40–53.
- (1981a). The Himalayas: summary of current knowledge of the status of pheasants. In *Pheasants in Asia, 1979* (ed. C. Savage) pp. 33–35. World Pheasant Association, Exning, Suffolk.
- (1981b). Field study techniques for censusing pheasants. In *Pheasants in Asia, 1979* (ed. C. Savage) pp. 44–48. World Pheasant Association, Exning, Suffolk.
- and Singh, J. (1980). The status of the cheer pheasant *Catreus wallichii* in the Chail Wildlife Sanctuary, Himachal Pradesh. *Wld Pheasant Ass. J.* **5**, 68–73.
- Hunter, M. L., Jr., and Garson P. J. (1981). The wildlife of Himachal Pradesh, western Himalayas. School of Forest Resources Technical Notes No. 82, University of Maine, Orono, 159 pp.

- Islam, K., and Crawford, J. A. (1983). The current status of the western tragopan. *Wld Pheasant Ass. J.* **8**, 40–49.
- Lelliott, A. D., and Ridley, M. W. (1982). Display flight of the male monal pheasant, *Lophophorus impejanus*. *Wld Pheasant Ass. J.* **7**, 90–1.
- Gates, J. M. (1966). Renesting behavior in the ring-necked pheasant. *Wilson Bulletin* **78**, 309–15.
- Gates, J. M. (1971). The ecology of a Wisconsin pheasant population. Ph.D. dissertation, University of Wisconsin, Madison.
- and Hale, J. B. (1974). Seasonal movements, winter habitat use, and population distribution of an east central Wisconsin pheasant population. Wisconsin Dept. of Natural Resources Technical Bulletin No. 76, pp. 1–55.
- and — (1975). Reproduction of an east central Wisconsin pheasant population. Wisconsin Dept. of Natural Resources Technical Bulletin No. 85, pp. 1–70.
- Gerrits, H. A. (1974). *Pheasants, including their care in the aviary*. Blandford Press, Poole, Dorset.
- Gilbert, S. and Greenwell, G. A. (1976). An unusually prolific breeding season in the Bornean great argus pheasant. *Int. Zoo Yearb.* **16**, 93–6.
- Glenister, A. G. (1951). *The birds of the Malay Peninsula, Singapore, and Penang: an account of the Malayan species with a note on their occurrence in Sumatra, Borneo, and Java, and a list of birds of those islands*. Oxford University Press, Oxford.
- Glutz, U. N. von Blotzheim (ed.) (1973). *Handbuch der Vogel Mitteleuropas* Vol. 5. *Galliformes und Gruiformes*, Akademische, Frankfurt.
- Goodwin, D. (1982). On the status of the green pheasant. *Bull. Br. Ornithol. Club* **102**, 35–7.
- Grahame, I. (1971). Breeding the Himalayan blood pheasant. *Avic. Mag.* **77** 195–201.
- (1976). The Himalayan blood pheasant: some further observations. *Wld Pheasant Assoc. J.* **1**, 15–21.
- Gray, A. P. (1958). *Bird hybrids: a check-list with bibliography*. Commonwealth Agricultural Bureaux, Farnham Royal.
- Grummt, W. (1980). Beitrag zur Systematik und Fortpflanzungsbiologie der in Gafangenschaft gehaltenen Weibchen Ohrfasanen, *Crossoptilon crossoptilon* (Hodgson). *Milu* **5**, 103–16 (with English summary).
- Guhl, A. M. (1953). The social behaviour of the domestic fowl. Kansas State College of Agriculture Technical Bulletin No. 73, pp. 1–48.
- and Fischer, G. J. (1969). The behaviour of chickens. In *The behaviour of domestic animals* (ed. E. S. E. Hafez). Ballière, Tindall and Cassell, London.
- Guiton, P. (1961). The influence of imprinting on the agonistic and courtship responses of the brown leghorn chick. *Anim. Behav.* **9**, 167–77.
- Guy, V. A new pheasant from Vietnam. In *Pheasants of Asia, 1982* (ed. F. C. R. Howman). World Pheasant Association, Exning, Suffolk. In press.
- Gysels, H. and Rabaye, M. (1962). Taxonomic relationships of *Afropavo congensis* Chapin 1935 by means of biochemical techniques. *Bull. Soc. R. Zool. Anvers* **26**, 71–9.
- Hachisuka, M. (1953). On hybrids between the green and copper pheasants. *Tori* **13**, 40–3.
- Hall, B. P. (1963). The francolins, a study in speciation. *Bull. Br. Mus. nat. Hist. (Zool.)* **10**, 105–204.
- Hamerstrom, F. N., Jr. (1936). A study of the nesting habits of the ring-necked pheasant in northwest Iowa. *Iowa State Coll. J. Sci.* **10**, 173–203.
- Hanebrinck, E. L. (1973). Characteristics and behaviour of a peafowl–guinea hybrid. *Game Bird Breeders Gaz.* **22**(2), 8–11.
- Hanson, W. R. (1970). Pheasant nesting and concealment in hayfields. *Auk* **87**, 714–9.
- Harrison, C. J. O. (1968). A note on the display of the Siamese fire-backed pheasant, *Lophura diardi*. 1968 Report of Pheasant Trust and Norfolk Wildlife Park. p. 15.
- and Wayre, P. (1969). The display of the koklass pheasant. 1969 Report of the Pheasant Trust and Norfolk Wildlife Park, pp. 16–19.
- and — (1975). The colour and pattern of the throat wattle of tragopans. 1975 Report of Pheasant Trust and Norfolk Wildlife Park, p. 20.
- Heinroth, O. (1938). Die Blaz des Bulwersfasan. *J. Ornithol.* **86**, 1–4.
- (1940). Pfauen- und Truthahnbalz. *Z. Tierpsychol.* **4**, 330–2.
- Heinz, C. H. and Gysel, L. W. (1970). Vocalization behavior of the ring-necked pheasant. *Auk* **87**, 279–95.
- Henry, C. M. (1955). *A guide to the birds of Ceylon*. Oxford University Press, Oxford.
- Hickey, J. J. (1955). Some American population research on gallinaceous birds. In *Recent studies in avian biology* (ed. A. Wolfson), pp. 326–95 University of Illinois Press, Urbana.
- Hoffman, D. M. (1973). Pheasant nest site selection. Colorado Division of Wildlife Special Report No. 32, pp. 1–27.
- Holmgren, S. T. 1974. Raising satyr and Temminck's tragopans. *Game Bird Breeders Gaz.* **21**(11), 11–14, (12), 27–30; **22**(2), 14–17, (3), 8–11.
- Hoogerwerf, A. (1949). Bijdrage tot de Oologie van Java. *Limosa* **22**, 1–289.
- (1950). De Avifauna van Tjiboda en Omgreving, inclusief het Natuurmonument Tjibodas-Gn. Gebe (West-Java). *Limosa* **23**, 1–158.
- Houpt, R. and Lastere, R. (1977). Captive breeding of the Salvadori's pheasant. *World Pheasant Ass. J.* **2**, 100–3.
- Howman, F. C. R. (1979). *Pheasants: their breeding and management*. K. and R. Books, Edlington, England.
- ed. (1984). *Pheasants in Asia, 1982. Proceedings of the second international pheasant symposium*, World Pheasant Association, Exning, Suffolk.
- Hudson, G. E. (1955). An apparent hybrid between the ring-necked pheasant and the blue grouse. *Condor* **57**, 304.



- Hüe, F., and Etchécopar, R. D. (1970). *Les oiseaux du proche et du Moyen Orient*. N. Boubée, Paris.
- Hulsemans, J. L. J. (1962). The comparative myology of the pelvic limb of *Afropavo congensis* Chapin 1936. *Bull. Soc. R. Zool. Anvers* **26**, 24–70.
- Huxley, J. (1941). The display of Rheinarth's pheasant. *Proc. Zool. Soc. Lond.* **111**, 277–8.
- Ingram, C. (1955). The order in which the remiges and rectrices are moulted in certain birds. *Acta XI Congr. Int. Ornithol.*, Basel, pp. 270–7.
- Islam, K. (1983). Distribution, habitat and status of the western tragopan in Pakistan. Proceedings of the Jean Delacour I.F.C.B. Symposium on Breeding Birds in Captivity. 22–27 February, Los Angeles, CA. pp. 37–44.
- . Distribution and status of the western tragopan in Pakistan. In *Pheasants of Asia, 1982* (ed. F. C. R. Howman). World Pheasant Association, Exning, Suffolk. In press.
- Jabouille, P. (1926). La reproduction du Rheinarth ocelle. *L'Oiseau* **7**, 227–9.
- . (1930). Le phenix fabuleux de le Chine and le faisan ocelle d'Annam. *L'Oiseau* **11**, 220–32.
- Jarvis, C. and Medway, Lord (1968). Sideways throwing and associated reproductive behaviour in the crestless fireback pheasant, *Lophura erythrophthalma*. 1968 Report of Ornamental Pheasant Trust and Norfolk Wildlife Park, pp. 13–14.
- Jeggo, D. (1972). Congo peafowl, *Afropavo congensis*. Jersey Wildlife Preservation Trust, 9th Annual Report. pp. 43–9.
- . (1973). Preliminary notes on the Palawan peacock pheasant (*Polyplectron emphanum*) breeding programme at the Jersey Zoological Park. Jersey Wildlife Preservation Trust, 10th Annual Report, pp. 76–81.
- . (1975). Breeding the Palawan peacock pheasant at Jersey Zoological Park. *Avic. Mag.* **81**, 8–12.
- Jewett, S. G. (1932). An unusual gallinaceous hybrid (*Phasianus* × *Dendragapus*). *Condor* **34**, 191.
- Johnsgard, P. A. (1973). *Grouse and quails of North America*. University of Nebraska Press, Lincoln.
- . (1982). Etho-ecological aspects of hybridization in the Tetraonidae. *Wld Pheasant Ass. J.* **7**, 42–57.
- . (1983a). Hybridization and zoogeographic patterns in pheasants. *Wld Pheasant Ass. J.* **8**, 89–98.
- . (1983b). *The grouse of the world*. University of Nebraska Press, Lincoln.
- Johnsingh, A. J. T. and Murali, S. (1980). The ecology and behaviour of the Indian peafowl (*Pavo cristatus* Linn.) of Injar. *J. Bombay Nat. History Society* **75** (suppl.), 1069–79.
- Johnson, F. E. B. (1964). Sonnerat's junglefowl (*Gallus sonnerati* Temminck). 1964 Ornamental Pheasant Trust Report, p. 18.
- Johnson, R. A. (1963). Habitat preference and behavior of breeding junglefowl in central western Thailand. *Wilson Bull.* **75**, 270–2.
- Juhn, M. (1937). The races of domestic fowl. *Nat. Geog.* **51**(4), 379–452.
- . (1938). Emergence orders and growth rates in the juvenile plumages of the brown leghorn. *J. Exp. Zool.* **77**, 467–89.
- Kabat, C., Thompson, D. R., and Kozlik, F. M. (1950). Pheasant weights and wing mold in relation to reproduction with survival implications. Wisconsin Conservation Dept. Technical Bulletin No. 2, 1–26.
- King, D. F. and Dickinson, E. C. (1975). *A field guide to the birds of South-East Asia*. Houghton Mifflin, Boston.
- King, W. B., ed. (1981). *Endangered birds of the world: The ICBP red data book*. Smithsonian Institution Press and International Council for Bird Preservation, Washington, D.C.
- Knoder, C. E. (1955). Reeves' pheasant investigation: Production-release pen study. *Ohio Wildl. Invest.* **6**(1), 48–51, 116–117.
- . (1963). Genetic analysis of hybrids between the avian genera *Syrnaticus* and *Phasianus*. *Game Res. Ohio* **2**, 215–22.
- . (1983). Elliot's pheasant conservation. *Wld Pheasant Ass. J.* **8**, 11–28.
- and Bailie, R. M. (1956). The ecology and breeding biology of the Reeves' pheasant on Tappan Island, 1955. *Ohio Wildl. Invest.* **7**, (3), 36–45.
- Koelz, W. N. (1954). Ornithological studies: new birds from Iran, Afghanistan and India. Privately printed, 33 pp.
- Korschgen, L. J. (1964). Foods and nutrition of Missouri and midwestern pheasants. Transactions of the 29th North American Wildlife Conference, pp. 159–81.
- Korschgen, L. J. and Chambers, G. D. (1970). Propagation, stocking and food habits of Reeves pheasants in Missouri. *J. Wildl. Manage.* **34**, 274–82.
- Koslowa, E. W. (1947). On the spring life and breeding habits of the pheasant in Tadjikistan. *Ibis* **89**, 423–8.
- Kozicky, E. L. and Hendrickson, G. O. (1951). The production of ring-necked pheasants in Winnebago County, Iowa. *Proc. Iowa Acad. Sci.* **58**, 491–5.
- Kruijt, J. P. (1962a). On the evolutionary derivation of wing display in Burmese red junglefowl and other gallinaceous birds. *Symp. Zool. Soc. Lond.* **8**, 25–35.
- . (1962b). Notes on wing display in the courtship of pheasants. *Avic. Mag.* **69**, 11–20.
- . (1964). Ontogeny of social behaviour in Burmese red junglefowl (*Gallus gallus spadiceus* Bonnaterrae). *Behaviour Suppl.* **12**, 201 pp.
- . (1966). The development of ritualized displays in junglefowl. *Phil. Trans. R. Soc. Lond.* **B251**, 479–84.
- Kuroda, N. (1981). The Japanese green pheasant *Phasianus colchicus* *versicolor* in Japan. *Wld Pheasant Ass. J.* **6**, 60–72.
- Lamba, B. S. (1981). Eastern India: Preliminary review. In *Pheasants of Asia, 1979* (ed. C. Savage), pp. 36–8. World Pheasant Association, Exning, Suffolk.
- . The pheasants of Kashmir. In *The Pheasants of Asia*,

1982. (ed. F. C. R. Howman). World Pheasant Association, Exning, Suffolk. In press.
- Lack, D. (1968). *Ecological adaptations for breeding in birds*. Oxford Univ. Press, Oxford.
- LaTouche, J. D. D. (1900). Notes on the birds of north-west Fokien. *Ibis* Ser. 7, 6, 34–60.
- Lelliott, A. D. (1981a). Cheer pheasants in west-central India. *Wld Pheasant Ass. J.* 6, 89–95.
- (1981b). Studies of Himalayan pheasants in Nepal, with reference to their conservation, M.Sc. thesis, Univ. of Durham, England.
- and Yonzon, P. B. (1980). Studies of Himalayan pheasants in Nepal. *Wld Pheasant Ass. J.* 5, 11–30.
- and Yonzon, P. B. (1981). Pheasant studies in Annapurna Himal. In *Pheasants of Asia, 1979* (ed. C. Savage). World Pheasant Association, Exning, Suffolk.
- Lewis, J. S. (1939). Courting display of Napoleon's peacock pheasant (*Polyplectron napoleonis*). *Avic. Mag. Ser.* 5(4), 233–5.
- Lill, A. and Wood-Gush, D. G. M. (1965). Potential ethological isolating mechanisms and assortative mating in the domestic fowl. *Behaviour* 25, 16–24.
- Long, J. L. (1981). *Introduced birds of the world*. A. H. and A. W. Reed, Sydney.
- Loughrey, A. G. and Stinson, R. H. (1955). Feeding habits of juvenile ring-necked pheasants in Pelee Island, Ontario. *Can. Fld. Nat.* 69, 59–65.
- Lovel, T. W. I. (1976). The present status of the Congo peacock. *Wld Pheasant Ass. J.* 1, 48–57.
- (1977). A stud book for the Edwards's pheasant. *Wld Pheasant Ass. J.* 2, 97–9.
- Lowe, P. R. (1925). Some notes on the genus *Polyplectron*. *Ibis* Ser. 12, 1, 476–84.
- (1939). Some preliminary notes on the anatomy and systematic position of *Afropavo congensis* Chapin. Proceedings of the 9th International Ornithological Congress, Rouen, pp. 219–30.
- Ludlow, F. and Kinnear, N. B. (1944). The birds of south-eastern Tibet. *Ibis* 86, 348–89.
- McAtee, W. L. (1945). The ring-necked pheasant and its management in North America. American Wildlife Institute, Washington, D.C.
- McCabe, R. A. (1949). A ten-year study of refuge populations of ring-necked pheasants. Ph.D. dissertation, Univ. of Wisconsin, Madison.
- MacMullan, R. A. (1960). Michigan pheasant populations. Michigan Dept. of Conservation, Game Division Report No. 2277, 169 pp.
- Mainardi, D. (1963). Immunological distances and phylogenetic relationships in birds. Proceedings XIII International Ornithological Congress, Ithaca, NY Vol. 1, pp. 103–14.
- Mallet, J. J. (1973). Notes on the breeding of eared pheasants at the Jersey Zoological Park. Jersey Wildlife Preservation Trust Annual Report No. 10, pp. 74–5.
- Mallinson, J. J. C. (1979). The establishment of viable captive populations of endangered bird species with special reference to the white eared pheasant *Crossoptilon crossoptilon* at the Jersey Zoological Park. *Wld Pheasant Ass. J.* 4, 81–92.
- and Taynton, K. M. (1978). White eared pheasant studbook number two. *Dodo* 15, 92–6.
- Marien, D. (1951). Notes on some pheasants from south-western Asia, with remarks on molt. *Am. Mus. Novit.* 1518, 1–25.
- Mayr, E. and Amadon, D. (1951). A classification of Recent birds. *Am. Mus. Novit.* 1496, 1–42.
- Medway, Lord, and Wells, D. R. (1976). *The birds of the Malay Peninsula* Vol. 5. Witherby, London.
- Miller, D. B. (1978). Species-typical and individually distinctive acoustic features of crow calls of red junglefowl. *Z. Tierpsychol.* 47, 182–93.
- Mitchell, P. C. (1911). On longevity and relative viability in mammals and birds; with a note on the theory of longevity. *Proc. Zool. Soc. Lond.*, 425–548.
- Mirza, Z. B. (1976). Pheasant restoration in Pakistan. 1976 Pheasant Trust and Norfolk Wildlife Park Annual Report, pp. 20–24.
- (1981a). Status of the pheasants in Pakistan. In *Pheasants of Asia, 1979* (ed. C. Savage) pp. 27–8. World Pheasant Association, Exning, Suffolk.
- (1981b). Cheer pheasant release programme in Pakistan. In *Pheasants of Asia, 1979* (ed. C. Savage) pp. 72–4. World Pheasant Association, Exning, Suffolk.
- Aleem, A., and Asghar, M. (1978). Pheasant surveys in Pakistan. *J. Bombay Nat. Hist. Soc.* 74, 292–6.
- Morejohn, G. V. (1968a). Study of plumage of the four species of the genus *Gallus*. *Condor* 70, 56–65.
- (1968b). Breakdown of isolation mechanisms in two species of captive junglefowl. *Evolution* 22, 576–82.
- Morris, D. (1957). Courtship of pheasants. *Zoo Life* 12, 8–13.
- Mueller, C. F. and Seibert, H. C. (1966). Wing and tail molt in the Reeves' pheasant. *Ohio J. Sci.* 66, 489–95.
- Muller, K. A. (1980). Now you see him—or did you? *Zoos* 53, 12–4.
- Norapuck, S. Survey of rarest pheasants of Thailand. In *Pheasants of Asia, 1982* (ed. F. C. R. Howman). World Pheasant Association, Exning, Suffolk. In press.
- Ogasawara, K. (1969). Winter habitats and food habits of the green and copper pheasants. *Misc. Rep. Yamashina Inst. Ornithol. Zool.* 5(4), 351–63 (in Japanese, English summary).
- Ogilvie-Grant, W. R. (1893). *Catalogue of the Game Birds . . . in the Collection of the British Museum* Vol. 22. British Museum (Natural History), London.
- Ollson, M. (1982). Firebacks: their captive management and propagation. *Game Bird Breeders Gaz.* 31(10–11), 8–10.
- Olsen, D. W. (1977). A literature review of pheasant habitat requirements and improvement methods. Utah State Dept. of Natural Resources, Publication No. 77–7.
- Olson, S. L. (1980). The significance of the distribution of the Megapodiidae. *Emu* 80, 21–4.



- Paludan, K. (1959). Results of pheasant marking in Denmark 1949–55. *Dan. Rev. Game Biol.* **4**, 1–23.
- Penrod, B., Dixon, M., and Smith, J. (1982). Renesting by ring-necked pheasants after loss of or separation from their brood. *N. Y. Fish Game J.* **29**, 209–10.
- Peters, J. L. (1934). *Check-list of birds of the world* Vol. 2. Harvard University Press, Cambridge, MA.
- Phillips, J. C. (1921). A further report on species crosses in birds. *Genetics* **6**, 366–83.
- Pocock, R. I. (1911). The display of the peacock pheasant. *Avic. Mag. Ser. 3* **2**, 229–37.
- Pollock, D. (1972). In search of the mikado pheasant. 1972 Annual Report of the Pheasant Trust and Norfolk Wildlife Park.
- Pratt, T. K. (1975). The kalij pheasant on Hawaii. *Elepaio* **36**, 66–7.
- Ridley, M. W. Patterns of social organization in the pheasant family. In *Pheasants of Asia, 1982* (ed. F. C. R. Howman). World Pheasant Association, Exning, Suffolk. In press.
- Riley, J. H. (1938). Birds from Siam and the Malay Peninsula in the U.S. National Museum collected by Dr Hugh M. Smith and William L. Abbott. *Bull. U.S. Natn. Mus.* **172**, 1–581.
- Rimlinger, D. S. (1984). Display behavior of the Temminck's tragopan. *World Pheasant Association Journal* **IX**, 19–32.
- Ripley, S. D. (1961). A synopsis of the birds of India and Pakistan, together with those of Nepal, Sikkim, Bhutan and Ceylon. Bombay Natural History Society, Bombay.
- Roberts, J. O. M. (1981). Status of the pheasants of Nepal. In *Pheasants of Asia, 1979* (ed. C. Savage) pp. 22–6. World Pheasant Association, Exning, Suffolk.
- Roberts, T. J. (1970). A note on the pheasants of west Pakistan. *Pak. J. For.* **20**, 319–26.
- Robertson, W. B., Jr. (1958). Investigations of ring-necked pheasants in Illinois. Illinois Dept. of Conservation, Bulletin No. 1, pp. 1–138.
- Robinson, H. C. and Chasen, F. N. (1936). *The birds of the Malay Peninsula* Vol. III. *Sporting birds: birds of the shore and estuaries*. Witherby, London.
- Roden, G. S. (1899). The courting dance of the moonal pheasant. *J. Bombay Nat. Hist. Soc.* **12**, 573–4.
- Roles, D. G. (1981). *Rare pheasants of the world*. Spur Publications, Liss, Hampshire.
- Rushen, J. (1982). The peck orders of chickens: how do they develop and why are they linear? *Anim. Behav.* **30**, 1129–37.
- Rutgers, A. and Norris, K. A., eds (1970). *Encyclopedia of aviculture* Vol. 1, Blandford Press, London.
- Sahin, R. (1984). Zur Balz des Mikado-Fasans (*Syrnaticus mikado*) in Gefangenschaft. *J. Ornithol.* **125**, 15–23.
- Sato, T., Ishii, T., and Hirai, Y. (1967). Genetic studies on serum protein in Phasianidae. 3. Immunoelectrophoresis comparison of the sera of domestic fowl, guinea fowl, and their hybrids. *Jap. J. Gen.* **42**, 51–9.
- Savage, C., ed. (1981). *Pheasants in Asia, 1979*. World Pheasant Association, Exning, Suffolk.
- Schäfer, E. (1934). Zur Lebensweise der Fasanen des chinesisch-tibetischen Grenzlandes. *J. Ornithol.* **82**, 487–509.
- Schenkel, R. (1956–58). Zur Deutung der Balzleistungen einiger Phasianiden und Tetraoniden. *Ornithol. Beobacht.* **53**, 182–201; **55**, 65–95.
- Schick, C. (1952). A study of pheasants on the 9000 acre prairie farm, Saginaw County, Michigan. Michigan Department of Conservation, Lansing, 134 pp.
- Schneider, A. (1938). Bau und Erection der Hautlappen von *Lobiophasis bulweri*. *J. Ornithol.* **86**, 5–8.
- Schwartz, C. W. and Schwartz, E. R. (1951). An ecological reconnaissance of the pheasants of Hawaii. *Auk* **68**, 281–314.
- Seibert, H. C. (1965). The history of the Reeves pheasant program in Ohio. *Ohio Game Monogr.* No. 1, 12 pp.
- and Donohoe, R. W. (1965). The history of the Reeves pheasant program in Ohio. *Ohio Game Monogr.* **1**, 1–20.
- Serebrovsky, A. S. (1929). Observations on interspecific hybrids of the fowl. *J. Gen.* **21**, 327–40.
- Seth-Smith, D. (1925a). The argus pheasant and its display. *Avic. Mag. Ser. 4*(3), 175–9.
- (1925b). On the display of the argus pheasant (*Argusianus argus*). *Proc. Zool. Soc. Lond.* **95**, 323–5.
- (1932). The display of Rheinart's pheasant. *Avic. Mag.* **4**(10), 122–3.
- Seubert, J. L. (1952). Observations on the renesting behavior of the ring-necked pheasant. Transactions of the 17th North American Wildlife Conference, pp. 305–29.
- Severinghaus, S. R. (1977). A study of the Swinhoe's and mikado pheasant in Taiwan with recommendations for their conservation. Ph.D. dissertation, Cornell University, Ithaca, NY.
- (1978). Recommendations for the conservation of the Swinhoe's and mikado pheasants in Taiwan. *Wld Pheasant Ass. J.* **3**, 79–89.
- (1979). Observations on the ecology and behavior of the koklass pheasant in Pakistan. *Wld Pheasant Ass. J.* **4**, 52–69.
- (1980). Swinhoe's pheasant in Taiwan. *Living Bird* **18**, 189–209.
- Mirza, Z. B., and Asghar, M. (1979). Selection of a release site for the re-introduction of cheer pheasants in Pakistan. *Wld Pheasant Ass. J.* **4**, 100–15.
- Sharma, I. (1972). Ecological study of breeding of the peafowl, *Pavo cristata*. *Alauda* **40**, 378–84 (in French, English summary).
- Sibley, C. G. and Ahlquist, J. E. (1972). A comparative study of the egg white proteins of non-passerine birds. *Peabody Mus. Nat. Hist. Bull.* **39**, 1–276.
- Siville, C. (1979). Tragopans. *Avic. Mag.* **85**, 199–209.
- Smil, V. (1983). Deforestation in China. *Ambios* **12**(5), 226–31.
- Smythies, B. E. (1953). *The birds of Burma*. (2nd edn). Oliver and Boyd, Edinburgh.

- (1981). *The birds of Borneo*. (3rd edn). Sabah Society and Malayan Nature Society, Kuala Lumpur.
- Snow, D. W. (1968). *An atlas of speciation in African non-passerine birds*. British Museum (Natural History), London.
- Stapel, C. (1976). Some observations on behaviour and display of peacock pheasants. *Wld Pheasant Ass. J.* **1**, 109–12.
- Steinbacher, G. (1941). Das Flugelschlagen der Fasane. *Zool. Gart. N.F.* **13**, 233–6.
- Steiner, H. (1945). Ueber letal Fehentwicklung der Zeiten Zackommenschafts-Generation bei tierischen Artbastarden. *Arch. Julius Klaus-Stift. Verebungforsch. Sozialanthropol. Rossenhyg.* **20**, 236–51.
- Stephens, C. H. (1966). Reeves' pheasant investigations in Kentucky. Kentucky Dept. Fish and Wildlife Resources Game Management Technical Series No. 15, 32 pp.
- Stock, A. B. and Bunch, T. D. (1982). The evolutionary implications of chromosome banding pattern homologies in the bird order Galliformes. *Cytogenet. Cell Biol.* **34**, 136–48.
- Stokes, A. W. (1954). Population studies of the ring-necked pheasant on Pelee Island, Ontario. Ontario Dept. of Lands and Forests, Technical Bulletin No. 4.
- and Williams, H. W. (1972). Courtship feeding in gallinaceous birds. *Auk* **89**, 177–80.
- Stresemann, E. (1965). Die Mauser der Huhnervogel. *J. Ornithol.* **106**, 58–64.
- Sumardja, E. A. (1981). First five national parks in Indonesia. *Parks* **6**(2), 1–4.
- Sutter, E. (1971). Ausbildung und Mauser der Flugelfieders beim juvenilen Jagdfasan *Phasianus colchicus*. *Ornithol. Beob.* **68**, 79–222.
- Taber, R. D. (1949). Observations on the breeding behavior of the ring-necked pheasant. *Condor* **51**, 153–75.
- Taichun, L., and Rusun, L. (1983). Brown eared pheasant: Studies of its ecology and biology. *Acta Zool. Sin.* **29**, 278–90 (in Chinese, with English summary).
- Taka-Tsukasa, N. (1929). The breeding of Rheinardt's argus pheasant in Japan. *Avic. Mag.* **5**(7), 306–9.
- (1933–43). *The birds of Nippon. I. Galli*. Tokyo.
- Tan, Y., and Wu, Z. (1981). A new subspecies of the silver pheasant from Guizhou, China. *Zool. Res.* **2**, 301–5 (in Chinese).
- Thompson, L. E. (1976). Methods of sexing eared pheasants. *Avic. Mag.* **82**, 39–50.
- Trautman, C. G. (1950). Determining the age of juvenile pheasants. *S.D. Conserv. Dig.* **17**(8), 8–10.
- (1952). Pheasant food habits in South Dakota. South Dakota Game, Fish and Parks Dept., Technical Bulletin No. 1, pp. 1–89.
- (1982). History, ecology and management of the ring-necked pheasant in South Dakota. South Dakota Game, Fish and Parks Dept., Technical Bulletin No. 7, pp. 1–118.
- Van den bergh, W. (1975). Breeding the Congo peacock at the Royal Zoological Society of Antwerp. In *Breeding endangered species in captivity* (ed. R. D. Martin) pp. 75–86. Academic Press, London.
- Vaurie, C. (1965). *The birds of the Palearctic fauna: non-passerines*. Witherby, London.
- (1972). *Tibet and its birds*. Witherby, London.
- Verheyen, R. (1956). Contribution de l'anatomie et a la systematique des Galliformes. *Bull. Inst. R. Sci. Nat. Belg.* **32**(42), 1–24.
- ed. (1962). Monograph du paon Congolais. *Bull. Soc. R. Zool. Averis* **26**, 3–94.
- (1965). Der Kongofau (*Afropavo congensis*). Neue Brehm-Bucherei No. 351. A. Ziemsen Verlag, Wittenberg, Lutherstadt.
- Wagner, F. H., Besadny, C. D., and Kabat, C. (1965). Population ecology and management of Wisconsin pheasants. *Wis. Conserv. Bull.* **35**, 1–168.
- Wang, Huen-Pu. (1980). Nature conservation in China: the present situation. *Parks* **5**(1), 1–10.
- Wayre, P. (1964). Display of the common koklass (*Pucrasia m. maculophya* Lesson). 1964 Report, Ornamental Pheasant Trust, p. 13.
- (1969). *A guide to the pheasants of the world*. Country Life, London.
- (1975). Breeding endangered pheasants in captivity as a means of ensuring their survival. In *Breeding Endangered Species in Captivity* (ed. R. D. Martin) pp. 87–97. Academic Press, London.
- (1978). The monals, genus *Lophophorus*. *Pheasant Trust Norfolk Wildl. Pk News* March, pp. 4–5.
- Wei-Shu, H. The pheasants of China. In *Pheasants of Asia*, 1982 (ed. F. C. R. Howman). World Pheasant Association, Exning, Suffolk. In press.
- Weigand, J. P. and Janson, R. G. (1976). Montana's ring-necked pheasant; history, ecology and management. Montana Dept. of Fish and Game, 178 pp.
- Westerskov, K. (1957). Growth and moult of pheasant chicks. New Zealand Dept. of Internal Affairs, Wildlife Publication No. 47, 64 pp.
- (1963). Evaluation of pheasant liberations in New Zealand based on a 12-year banding study. New Zealand Dept. of Internal Affairs, Wildlife Publication No. 71, 67 pp.
- (1974). Distribution and life-history of the ring-necked pheasant (*Phasianus colchicus karpowi*) in Korea. *N.Z. Wildl.* **46**, 7–9, 11–19.
- Wetmore, A. (1960). A classification for the birds of the world. *Smithson. Misc. Collect.* **139**(11), 1–37.
- Woehler, E. E. and Gates, J. M. (1970). An improved method of sexing ring-necked pheasants. *J. Wildl. Manage.* **34**, 228–31.
- Wolters, H. E. (1975–82). *Die Vogelarten der Erde*. Paul Parey, Hamburg.
- Wood-Gush, D. G. M. (1954). The courtship of the brown leghorn cock. *Br. J. Anim. Behav.* **2**, 95–102.
- (1955). The behaviour of the domestic chicken: a review of the literature. *Br. J. Anim. Behav.* **3**, 81–110.



- (1956). The agonistic and courtship behaviour of the brown leghorn cock. *Br. J. Anim. Behav.* **4**, 133–42.
- (1971). *The behaviour of the domestic fowl*. Heine-  
mann, London.
- Yamashina, Y. (1976). Notes on the Japanese copper pheasant *Phasianus soemmeringii*. *Wld Pheasant Ass. J.* **1**, 23–42.
- Yin (1970). Record of the Himalayan monal *Logophorus impeyanus* (Latham) in Burma. *J. Bombay Nat. Hist. Soc.* **67**, 328–330.
- Yonzon, P. B. and Lelliott, A. D. (1981). Human interference in ecosystems. In *Pheasants in Asia, 1979* (ed. C. Savage) pp. 55–62. World Pheasant Association, Exning, Suffolk.
- Zeliang, D. K. 1981. Blyth's tragopan breeding centre, Kohima Nagaland. In *Pheasants of Asia, 1979* (ed. C. Savage) pp. 88–91. World Pheasant Association, Exning, Suffolk.





# Index

This index includes the scientific and English vernacular names of pheasant genera, species, and subspecies only; members of other bird groups are not indexed. Complete indexing is limited to the English vernacular names that are used in the text. Principal accounts of each genus and species are indicated by *italics*; maps or drawings outside of species accounts are indicated by **bold face**.

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